U.S. DEPARTMENT OF COMMERCE
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PB-285 098

Proposed Issuance of a New Source National Pollutant Discharge Elimination System Permit and Section 10 and Section 404 Permits to Iowa Southern Utilities Company, Ottumwa Generating Station

Environmental Protection Agency, Kansas City, MO

Aug 78

PB 285 098

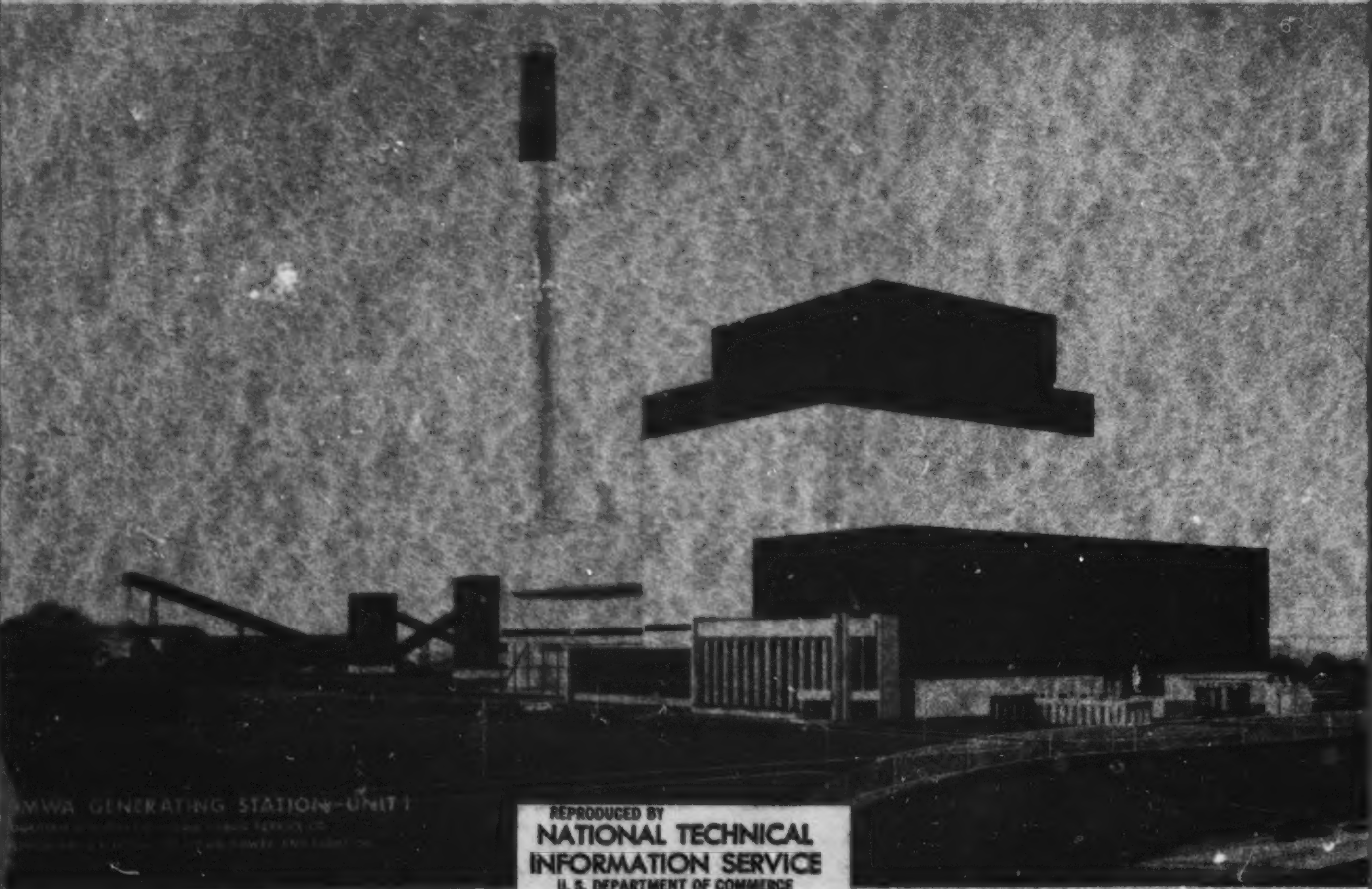
EPA-907/9-78-001

EPA-7-IA-Ottumwa-Wapello-NSDP-78

FINAL ENVIRONMENTAL IMPACT STATEMENT

Ottumwa Generating Station

IOWA SOUTHERN UTILITIES COMPANY



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Region VII, Kansas City, Missouri

AUGUST 1978

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Prepared in conjunction with U.S. Army Engineers, Rock Island, Illinois District

16. ABSTRACT
The U.S. Environmental Protection Agency (EPA) is considering the issuance of a new source of National Pollutant Discharge Elimination System (NPDES) permit (P.L. 95-217 Section 402) for discharge of wastewaters from Iowa Southern Utilities' proposed Ottumwa Generating Station (OGS). Pursuant to the National Environmental Policy Act of 1969 (P.L. 91-190), EPA has prepared this environmental impact statement (EIS) to evaluate the potential impacts of this action on the Des Moines River, the cities of Chillicothe and Ottumwa, and the surrounding areas. This EIS is a multiagency document prepared in conjunction with the U.S. Army Corps of Engineers. It will serve as the Corps of Engineers' EIS in the issuance of a Section 10, River and Harbors Act permit.

The proposed site for the 727 megawatt coal-fired steam-electric generating station is located adjacent to the Des Moines River approximately 8 miles northwest of Ottumwa, Iowa. Its estimated cost is $300 million.

OGS will utilize a closed-cycle cooling system and will require make-up water at a rate of 17 cfs at maximum load conditions. Total discharge to the Des Moines River is estimated to be 1.4 cfs at maximum load conditions. Low sulfur western coal will fuel the plant at a rate of 2,200,000 tons per year. Principal constituents of the plant stack emissions are particulate matter, sulfur oxides, nitrogen oxides and

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

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various trace elements. An electrostatic precipatator will be used to control particulate matter. Selection of low sulfur coal will minimize SO_2 emissions, and furnace design will control NO_2.

EPA-7-IA-Ottumwa-Wapello-NSDP-78
NPDES Permit Number IA-0060909
August 1978

FINAL ENVIRONMENTAL IMPACT STATEMENT

On Proposed Issuance of a New Source National Pollutant Discharge Elimination System Permit and Section 10 and Section 404 Permits to

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION

prepared by
U.S. Environmental Protection Agency
Region VII, Kansas City, Missouri

in conjunction with
U.S. Army Corps of Engineers
Rock Island, Illinois, District

with technical assistance by
Black & Veatch Consulting Engineers
Kansas City, Missouri

approved by

Kathleen Q Camin
Regional Administrator (date)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
1735 BALTIMORE
KANSAS CITY, MISSOURI 64108

AUG 28 1977

TO: ALL INTERESTED GOVERNMENTAL AGENCIES, PUBLIC GROUPS, AND CITIZENS

Enclosed with this notice is a copy of the Final Environmental Impact Statement (EIS) for the Ottumwa Generating Station. This document is submitted for your review and comment pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 (Public Law 91-190). All comments submitted to this agency on the Draft EIS and EPA's responses have been incorporated into the Final EIS.

The principal owner of the power plant, Iowa Southern Utilities Company, has applied for Environmental Protection Agency and U.S. Army Corps of Engineers permits. This document serves as the EIS for these two agencies and has been used to evaluate the environmental impacts of their actions.

Comments should be submitted to this office within 30 days of the date the Environmental Protection Agency publishes notice of the EIS in the Federal Register.

Additional copies of this statement are available for review in the EPA Region VII Library and the Ottumwa Public Library, Ottumwa, Iowa. Please direct your comments to:

U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

We appreciate the time and effort you will spend in reviewing the EIS.

Sincerely yours,

Kathleen Camin

Kathleen Q. Camin, Ph.D.
Regional Administrator

Enclosure

STATEMENT OF FINDINGS

The interpretation and evaluation of information collected during the Environmental Impact Statement (EIS) process on the Ottumwa Generating Station has resulted in the following determinations:

1. Upon completion of the public disclosure process, the U.S. Army Corps of Engineers, Rock Island District, will publish a Findings of Fact regarding the proposed issuance of a Section 10 (construction) permit. The public disclosure process entails a public notice and an opportunity for public comment ending 30 days after the date of the public notice.

2. As of August 10, 1978, Iowa assumed the authority from the Environmental Protection Agency to issue National Pollutant Discharge Elimination System (NPDES) permits as required under Section 402 of the Clean Water Act of 1977 (P.L. 95-217). After evaluating the information relevant to Iowa's issuance of the NPDES permit, we recommend that the permit be issued with the following conditions included:

   a. Due to the nature of the soil at the southern end of the fly ash basin, we recommend that a groundwater monitoring program be formulated which would monitor for leachates from the fly ash basin migrating into and contaminating the groundwater.

   b. When an alternative water supply source for low flow periods has been decided upon, water quality from that source should be analyzed to ensure that it is acceptable to be discharged to the Des Moines River.

Kathleen Q. Camin

Kathleen Q. Camin, Ph.D.
Regional Administrator

8/28/78
Date

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I Public Hearing Proceedings

SUMMARY

OTTUMWA GENERATING STATION

( ) DRAFT (X) FINAL

RESPONSIBLE OFFICE: U.S. Environmental Protection Agency, 1735 Baltimore, Kansas City, Missouri 64108, telephone 816-374-2921.

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action and Proposed Project: The U.S. Environmental Protection Agency (EPA) is considering the issuance of a new source National Pollutant Discharge Elimination System (NPDES) permit (P.L. 92-500, Section 402) for discharge of wastewaters from Iowa Southern Utilities' proposed Ottumwa Generating Station (OGS). Pursuant to the National Environmental Policy Act of 1969 (P.L. 91-190), EPA has prepared this environmental impact statement (EIS) to evaluate the potential impacts of this action on the Des Moines River, the cities of Chillicothe and Ottumwa, and the surrounding areas. This EIS is a multiagency document, prepared in conjunction with the U.S. Army Corps of Engineers. It will serve as the Corps of Engineers' EIS in the issuance of a Section 404, Federal Water Pollution Control Act Amendments permit and a Section 10, River and Harbors Act permit.

The proposed site for the 727 megawatt coal-fired steam-electric generating station is located adjacent to the Des Moines River approximately 8 miles northwest of Ottumwa, Iowa. Its estimated cost is $300 million.

OGS will utilize a closed-cycle cooling system and will require make-up water at a rate of 17 cfs at maximum load conditions. Total discharge to the Des Moines River is estimated to be 1.4 cfs at maximum load conditions. Low sulfur western coal will fuel the plant at a rate of 2,200,000 tons per year. Principal constituents of the plant stack emissions are particulate matter, sulfur oxides, nitrogen oxides, and various trace elements. An electrostatic precipatator will be used to control particulate matter. Selection of low sulfur coal will minimize SO_2 emissions, and furnace design will control NO_2.

3. Environmental Impacts: The Des Moines River will be impacted by water withdrawl and discharge of wastewaters. This wastewater consists of effluents from plant wastewater treatment systems and sanitary waste treatment systems. Runoff from the coal pile will also be discharged. Approximately 795 acres of agricultural land and wildlife habitat will be converted to industrial use. Local populations will have higher noise levels and air pollution to contend with.

Unavoidable Adverse Environmental Effects: Noise and dust during construction activities will be a temporary impact. Levels of SO_2, NO_x, ozone, and particulate matter will increase. Damage or death of aquatic organisms will result from their impingement on the intake structure and entrainment into the circulating water system during plant operation.

4. Alternatives: The alternatives available to EPA include: (1) issuance of a new source NPDES permit; (2) issuance of a conditional new source NPDES permit, or a NPDES permit for a modified facility, (3) denial of a new source NPDES permit (no action).

Alternatives considered in this EIS include: (1) no action; (2) purchase of power; (3) conservation of energy; (4) alternate fuel sources; (5) facility sites; (6) facility design variations.

5. Comments Requested:

Federal Agencies

Council on Environmental Quality
U.S. Department of Agriculture
- **Forest Service**
- **Soil Convervation Service**

U.S. Department of Commerce
U.S. Department of Health, Education, and Welfare
U.S. Department of Housing and Urban Development
- **Regional Administrator, Region VII**
- **Area Director**

U.S. Department of the Interior
U.S. Department of Transportation
- **Federal Highway Administration**
- **Federal Aviation Administration**
- **Coast Guard**

Federal Power Commission
Advisory Council on Historic Preservation
Water Resource Council
Federal Energy Administration
Upper Mississippi River Basin Commission

Members of Congress

Richard Clark, U.S. Senator
John C. Culver, U.S. Senator
James Leach, U.S. House of Representatives
Neal Smith, U.S. House of Representatives

State

A-95 Federal Funds Coordinator
Gene Glenn, State Senator
Forrest Schengels, State Senator
Mattie Harper, State Representative
Floyd H. Miller, State Representative
Charles N. Poncy, State Representative
Iowa Department of Environmental Quality
Iowa State Conservation Commission
State Historical Department
State Library Commission of Iowa

Local and Regional

Mayor, Chillicothe, Iowa
Mayor, Ottumwa, Iowa
Area XI Regional Planning Commission
Area XV Regional Planning Commission
Iowa Association of Soil Conservation District Commissioners
State Association of County Conservation Boards

Interested Groups and Individulas

National Forest Products Association
Iowa Coal Project
St. Louis University
Iowa State University
University of Iowa
Fluor Pioneer Company
Iowa Association of Municipal Utilities
Iowa Academy of Science
Iowa Wildlife Federation
Indian Hills Community College
Iowa Ornithologists' Union
Iowa Conservation Education Council, Inc.
Iowa Confederation of Environmental Organizations
League of Women Voters of Iowa
Nature Conservancy, Iowa Chapter
Sierra Club, Iowa Chapter
State Preserves Board
J.N. "Ding" Darling Foundation, Inc.
Environmental Coordinating Council
Izaak Walton League of America, Iowa Division
Keep Earth's Environment Pure
Calhoun County Environmental Action
Audubon Society, Des Moines Chapter
Society of American Foresters
National Audubon Society
Wildlife Society
Iowa Commercial Fisheries Association
Ducks Unlimited
National Resources Council
Environmental Coordinating Council
Environmental Law Society
Citizens United for Responsible Energy
People's Energy Project
Citizens for Environmental Action
Community Action Research Group
Jim Crane
Scott Jones
Chuck Steffen

GLOSSARY

Adjusted Net Capability--The net buying and generating capacity for the system as a whole.

Adjusted Net Capacity--Refers to the rating of a single generator.

Aquifer--A stratum or zone below the surface of the earth capable of transporting and storing water. The water usually flows through pores or cracks in the rock.

Ash--The solid residue following combustion of a fuel.

Ash Sluice--The transport of solid residue ash by water flow in a conduit.

Base Load--The minimum load over a given period of time.

Benthic--As related to benthos, plant or animal organisms attached or resting on the bottom or living in the bottom sediments of a freshwater body.

Biota--The plant and animal life of a given locale, area, or region.

Block Rate--A type of metered rate. A certain specified price per unit is charged for all or any part of a block of units, and reduced prices per unit are charged for all or any part of succeeding blocks of such units, each such reduced price per unit applying only to a particular block or portion thereof.

Blowdown--A portion of water in a closed system which is wasted in order to prevent a build-up of dissolved solids.

BOD--Biochemical oxygen demand. The BOD value represents the amount of oxygen required by bacteria to decompose aerobically an amount of organic matter in a given period of time at a stated temperature.

Bottom Ash--The solid residue left from the combustion of a fuel, which falls to the bottom of the combustion chamber.

cfs--cubic feet per second. The rate of flow of a measured volume of water.

Circulating Water System--A system which conveys cooling water from its source to the main condensers and then to the point of discharge. Synonymous with cooling water system.

Cooling Tower--A configured heat exchange device which transfers reject heat from circulating water to the atmosphere.

Copepods--A zooplankton form.

DDT--Dichlorodiphenyltrichloroethane, an insecticide classified as a chlorinated hydrocarbon or organochlorine.

Demand Rate--Any method of charge for electric service which is based upon or is a function of the rate of use, or size, of the customer's installation or maximum demand (expressed in kilowatts, kilovoltamperes, or horsepower) during a given period of time.

Derivative Effect--The investment of funds, equipment, and manpower during the creation or expansion of productive facilities generates a multiple expansion of employment and of related income. This multiple expansion is called "the multiplier effect."

Diatom--A principal type of algae whose cell walls consist of two boxlike parts or valves that contain silica.

Discharge--To release or vent.

Ecosystem--Any area of nature that includes organisms and nonliving substances interacting to produce an exchange of materials between the living and nonliving parts.

Environment--All the conditions, circumstances and influences surrounding and affecting the development of an organism or group of organisms.

Electrostatic Precipitator--A device for removing particles from a stream of gas based on the principle that these particles carry electrostatic charges and can therefore be attracted to an electrode by imposing a potential across the stream of gas.

Embankment--The non-concrete portion of the dam, consisting of compacted earthen materials.

Epicenter--The area of the earth's surface directly above the place of origin, or focus, of an earthquake.

Fauna--Refers to all animal species found in an area.

Flat Rate--A type of demand rate. A charge for electric service based upon the customer's installation of energy-consuming devices. This is usually so much per watt, per kilowatt, or per horsepower, per month or per year. Sometimes this type of rate is nominally so much per customer per year, or per month, for each of various classes of customers, but estimated demand and quantity of energy likely to be used play an important part in the determination of the class.

Flora--Refers to all the plant species found in an area.

Flue Gas--The gaseous products resulting from the combustion process after passage through the boiler.

Fly Ash--A portion of the non-combustible residue from a fuel which is carried out of the boiler by the flue gas.

fps--feet per second.

gpm--gallons per minute.

Habitat--The place where a given species lives, generally the kind of place rather than a geographic location.

Heptachlor--A biocide classified as a chlorinated hydrocarbon.

Herbaceous--Of, or having the nature of an herb; like a green leaf in texture, color, and shape.

Herbivores--Primary consumer organisms that feed directly on living plants or plant remains.

Kilowatt(kW)--1000 watts.

Kilowatt-hour (kWh)--The basic unit of electric energy equal to 1 kilowatt of power supplied to or taken from an electric circuit steadily for 1 hour.

Lentic--Standing water conditions such as lakes, ponds, or swamps.

Load--The amount of electric power delivered or required at any specified point or points on a system. Load originates primarily at the power consuming equipment of the customers.

Load Center--A point at which the load of a given area is assumed to be concentrated.

Meter Rate--Any method of charge for electric service based solely upon quantity, such as kilowatt-hours used.

Multiplier Effect--Synonymous with derivative effect.

Periphyton--Freshwater organisms (both plant and animal) attached or clinging to stems and leaves of rooted plants or other surfaces projecting above the bottom.

Phytoplankton--Producer organisms. Minute floating plants, usually called algae, distributed throughout the pond as deep as light penetrates. In abundance, the phytoplankton gives the water a greenish color; otherwise, they are not visible to the observer.

Plankton Communities--Floating, microscopic (plant and animal) organisms whose movements are more or less dependent on currents.

Primary Succession--Succession developing on an area which has not been previously occupied by a community (such as newly exposed rock or sand surface).

Regeneration--Displacement from ion exchange resins of the ions removed from the process solution.

Regional Econometric Model--A computerized, empirical model which describes a regional economy based on historical economic interrelationships. The specification of economic relationships in the model's equations are based on economic theory and experimental testing.

Rotifer--A zooplankton form.

Secondary Succession--Community development proceeding in an area from which a community was removed (such as a plowed field or cutover forest).

Service Area--Territory in which a utility system is required or has the right to supply electric service to ultimate customers.

Sludge--Accumulated solids separated from a liquid during processing.

Steam Generating Station--An electric generating station in which the prime mover is a steam turbine. The steam is generated in a boiler by heat burning from fossil fuels.

Steam Generator--The equipment which uses a heat source to change water into steam.

Steam Turbine--An enclosed rotary type of prime mover in which heat energy in steam is converted into mechanical energy by the force of high velocity flow of steam directed against successive rows of radial blades fastened to a central shaft.

Succession--The orderly and progressive replacement of one community by another until a relatively stable community occupies the area.

Terrestial--Referring to organisms (plant and animal) that live on land as opposed to those that live in water.

Uplands--Refers to habitat and associated species in the upper (land) elevations of the project, as opposed to that found within the flood plain.

Zooplankton--Consumer organisms. Minute animal plankton; a type of herbivore.

I PROJECT DESCRIPTION

1.01 **Introduction**. Iowa Southern Utilities Company (ISU) and three other utility companies propose to jointly construct and operate a coal-fired steam-electric generating plant on a site located in Wapello County, Iowa about 8 miles northwest of Ottumwa at approximately River Mile 106 on the Des Moines River. The location of the Ottumwa Generating Station (OGS) is shown on Figure 1-1 and ISU's service area is shown in Figure 1-2.

1.011 The participating companies and their per cent ownership of the proposed facility are shown in Table 1-1.

Table 1-1

OWNERS OF THE OTTUMWA GENERATING STATION

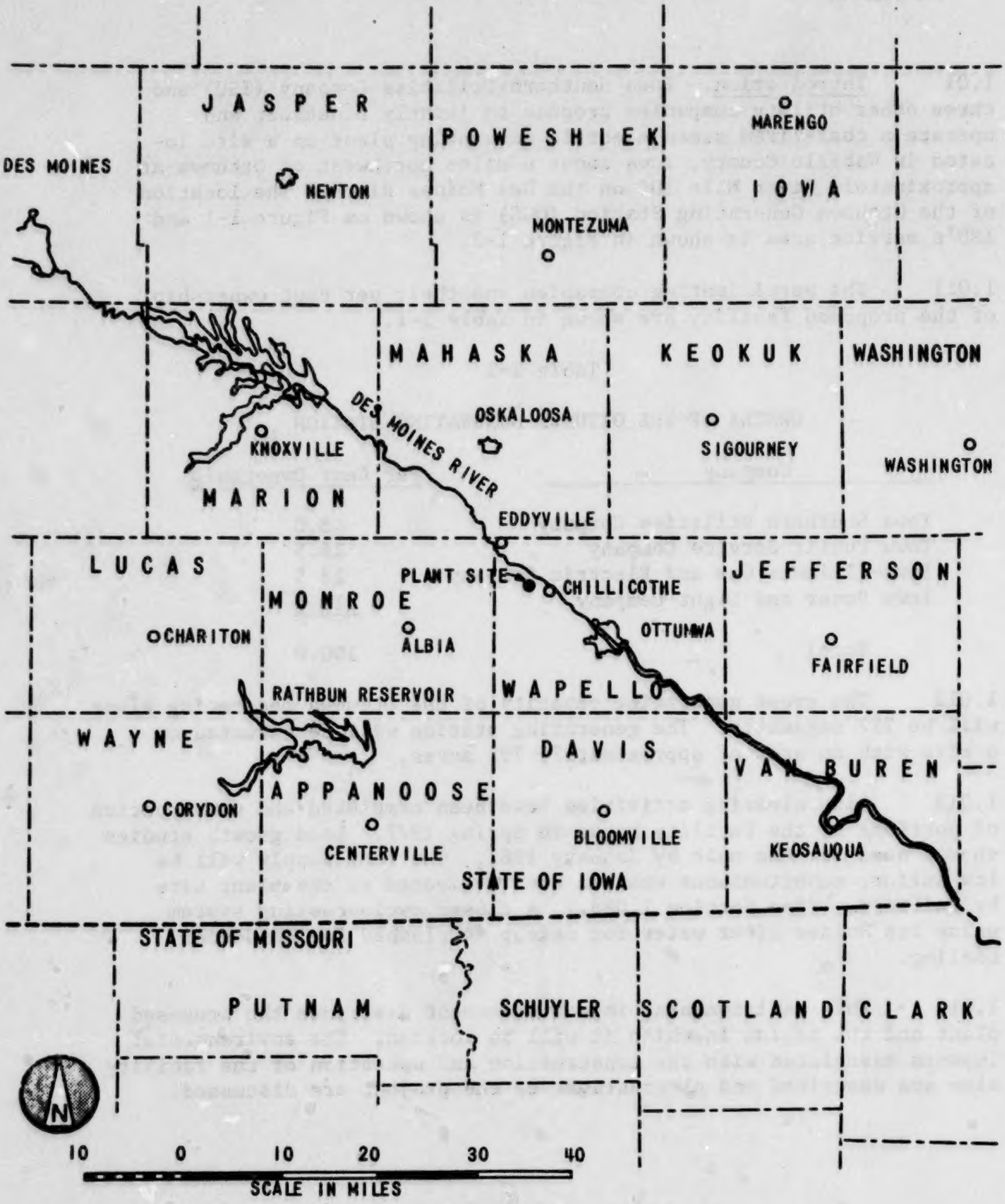
Company	Per Cent Ownership
Iowa Southern Utilities Company	48.0
Iowa Public Service Company	18.5
Iowa-Illinois Gas and Electric Company	18.5
Iowa Power and Light Company	15.0
Total	100.0

1.012 The gross generating capacity of the Ottumwa Generating Plant will be 727 megawatts. The generating station will be situated on a site with an area of approximately 795 acres.

1.013 Site clearing activities have been completed and construction of portions of the facility began in Spring 1977. Load growth studies show a need for the unit by January 1981. The fuel supply will be low sulfur, subbituminous western coal delivered to the plant site by railroad. (See Section 1.048.) A closed cycle cooling system using Des Moines River water for makeup is planned for condenser cooling.

1.014 This environmental impact statement describes the proposed plant and the region in which it will be located. The environmental impacts associated with the construction and operation of the facility also are described and alternatives to the project are discussed.

FIGURE I-1



LOCATION OF THE OTTUMWA GENERATING STATION

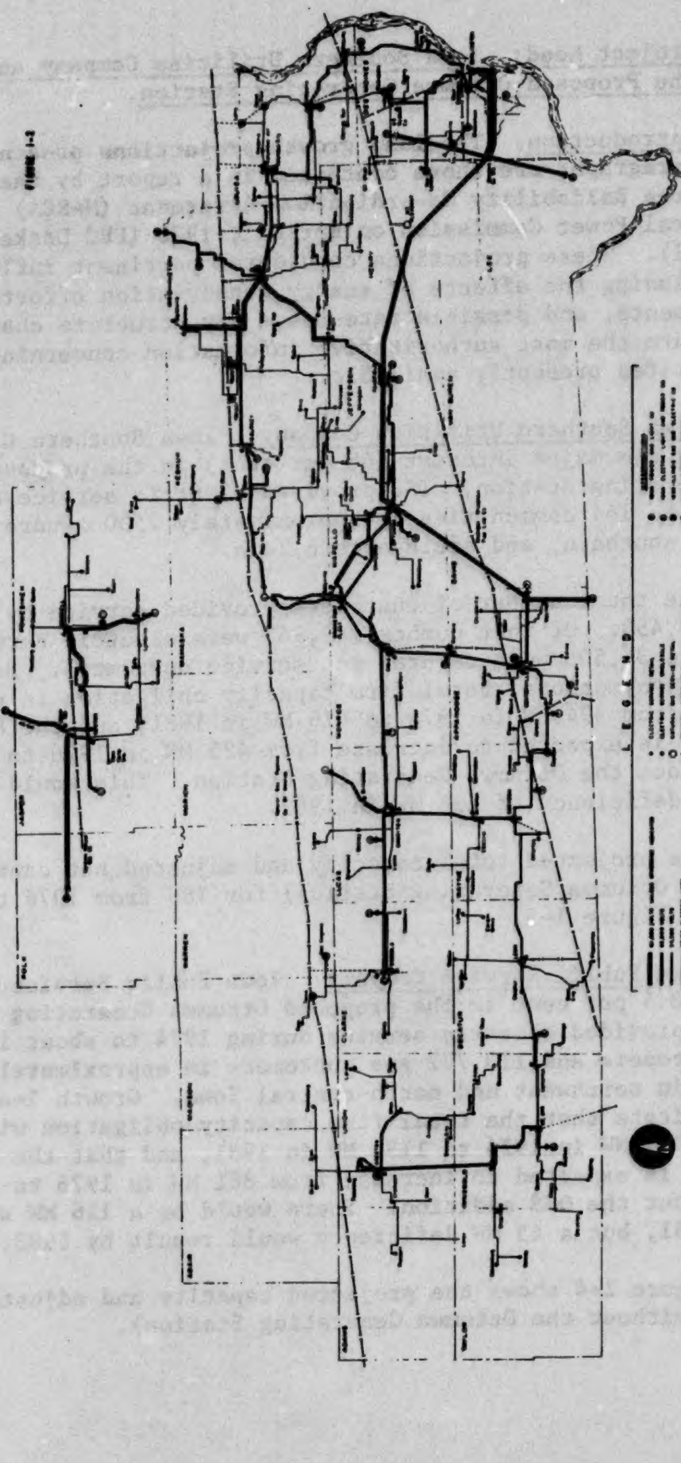


FIGURE I-2
IOWA SOUTHERN UTILITIES COMPANY
SERVICE AREA
LEGEND
SCALE IN MILES

1.02 Project Need: Iowa Southern Utilities Company and Other Owners of the Proposed Ottumwa Generating Station.

1.021 Introduction. The load growth projections presented in the following paragraphs are those contained in a report by the Mid-Continent Area Reliability Co-ordination Agreement (MARCA) submitted to the Federal Power Commission on April 1, 1976 (FPC Docket R362, Appendix A-1). These projections considered pertinent influencing factors including the effects of energy conservation efforts, natural gas curtailments, and possible rate-usage pay structure changes. These data are the most authoritative information concerning energy demand estimates presently available.

1.022 Iowa Southern Utilities Company. Iowa Southern Utilities Company owns the major interest (48 per cent) in the proposed Ottumwa Generating Station. ISU provides electric service and natural gas to 164 communities in approximately 7500 square miles in central, southern, and southeastern Iowa.

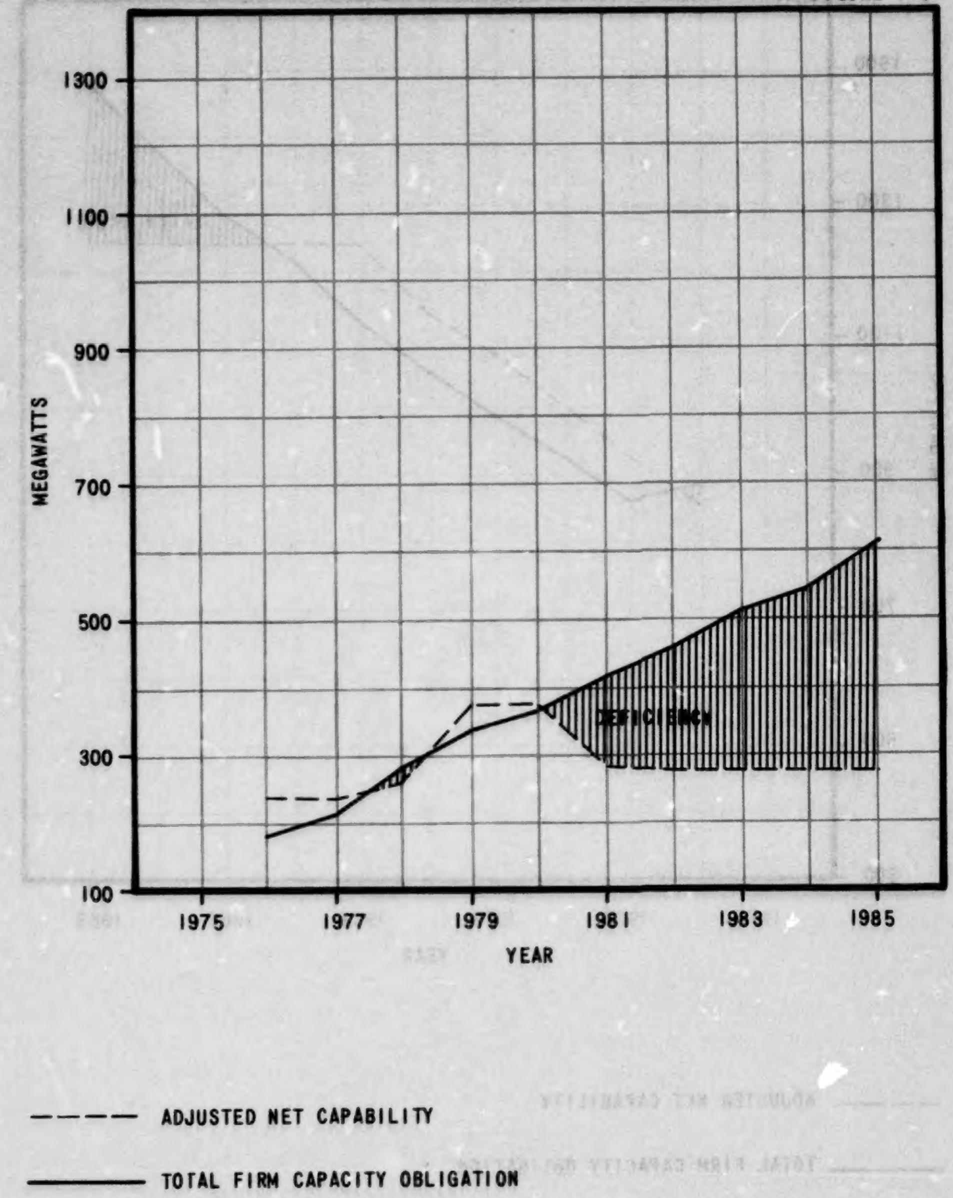
1.0221 The total number of customers provided service by ISU in 1974 was 123,453. Of that number, 87,947 were electric service customers and 35,506 were natural gas service customers. Based on load growth projections, total firm capacity obligation is expected to increase from 394 MW in 1976 to 616 MW in 1981, and the adjusted net capacity is expected to increase from 425 MW in 1976 to 478 MW in 1981 without the Ottumwa Generating Station. This would result in a system deficiency of 138 MW in 1981.

1.0222 The projected total capacity and adjusted net capability (without the Ottumwa Generating Station) for ISU from 1976 to 1985 are shown on Figure 1-3.

1.023 Iowa Public Service Company. Iowa Public Service Company (IPS) owns 18.5 per cent in the proposed Ottumwa Generating Station. The company provided electric service during 1974 to about 145,549 electric customers and 113,777 gas customers in approximately 323 communities in northwest and north-central Iowa. Growth load projections indicate that the total firm capacity obligation will increase from 881 MW in 1976 to 1130 MW in 1981, and that the adjusted net capacity is expected to increase from 861 MW in 1976 to 1246 MW in 1981 without the OGS addition. There would be a 116 MW system excess in 1981, but a 45 MW deficiency would result by 1983.

1.0231 Figure 1-4 shows the projected capacity and adjusted net capability (without the Ottumwa Generating Station).

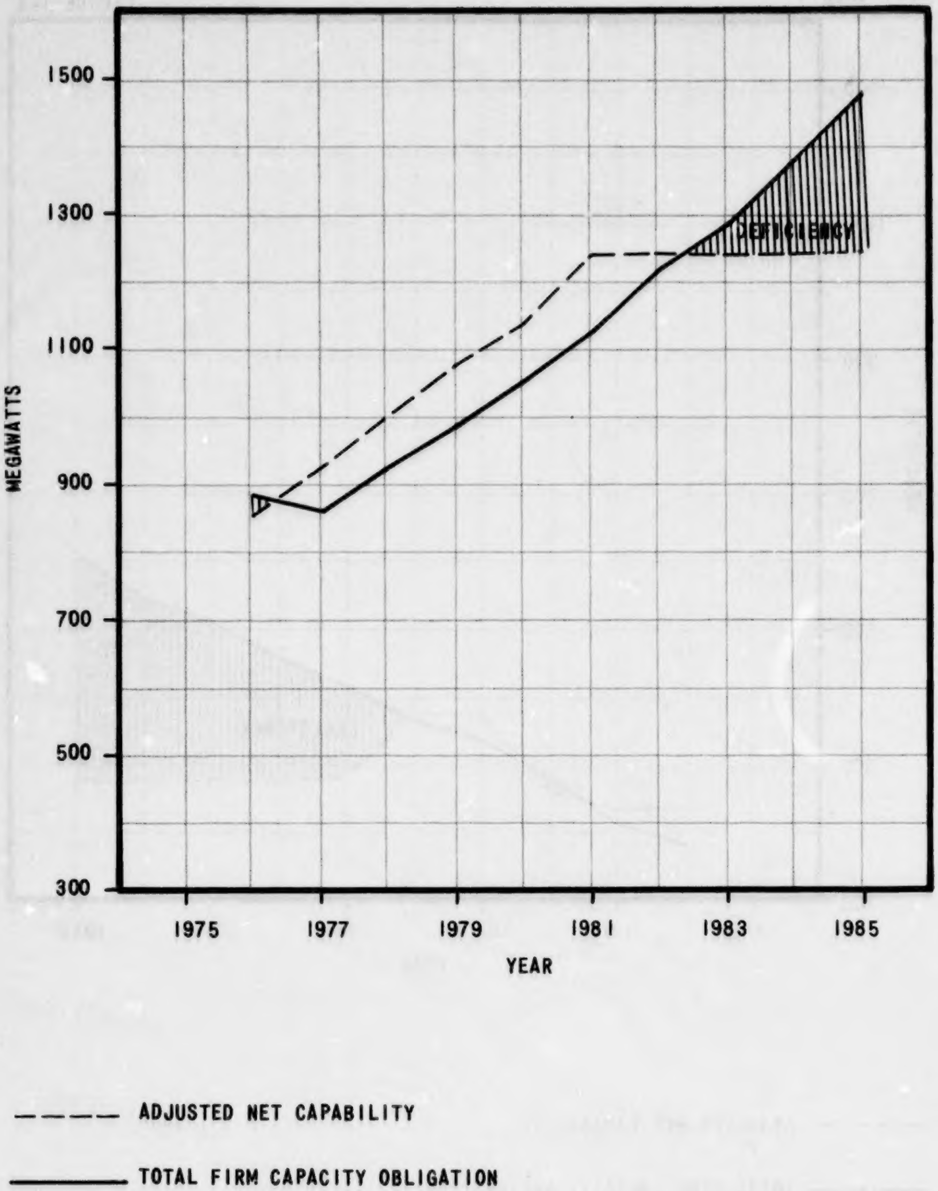
FIGURE I-3



SOURCE: REPORT BY MID-CONTINENT AREA RELIABILITY CO-ORDINATION AGREEMENT (MARCA) TO FEDERAL POWER COMMISSION, FPC DOCKET R362, APPENDIX A-1, APRIL 1, 1976.

PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF IOWA SOUTHERN UTILITIES COMPANY - 1976-1985

FIGURE I-4



SOURCE: REPORT BY MID-CONTINENT AREA RELIABILITY CO-ORDINATION AGREEMENT (MARCA) TO FEDERAL POWER COMMISSION, FPC DOCKET R362, APPENDIX A-1, APRIL 1, 1976.

PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF IOWA PUBLIC SERVICE COMPANY - 1976-1985

1.024 Iowa-Illinois Gas and Electric Company. A total of 18.5 per cent of the proposed generating station is owned by Iowa-Illinois Gas and Electric Company. In 1974 the Company provided electric service to 153,279 customers and natural gas to 197,102 customers.

1.0241 Based on projected sales and other commitments, the total firm capacity requirement will increase from 1015 MW in 1976 to 1413 MW in 1981, and the adjusted net capability is expected to increase from 1082 MW in 1976 to 1285 MW in 1981 without the OGS addition. This results in a system deficiency of 128 MW in 1981.

1.0242 The projected total firm capacity obligation and adjusted net capability for the company (without the Ottumwa Generating Station) for the period 1976 through 1985 are shown on Figure 1-5.

1.025 Iowa Power and Light Company. Iowa Power and Light Company owns 15 per cent of the Ottumwa Generating Station. There are 206,000 electric and 127,000 gas customers (1975), within the company's 5600 square mile service area which includes 202 communities.

1.0251 Base load projections show that the total firm capacity obligation of the company will increase from 1160 MW in 1976 to 1556 MW in 1981. Adjusted net capability is expected to increase from 1218 MW in 1976 to 1502 MW in 1981 without OGS. Without OGS the resulting system deficiency is 54 MW in 1981.

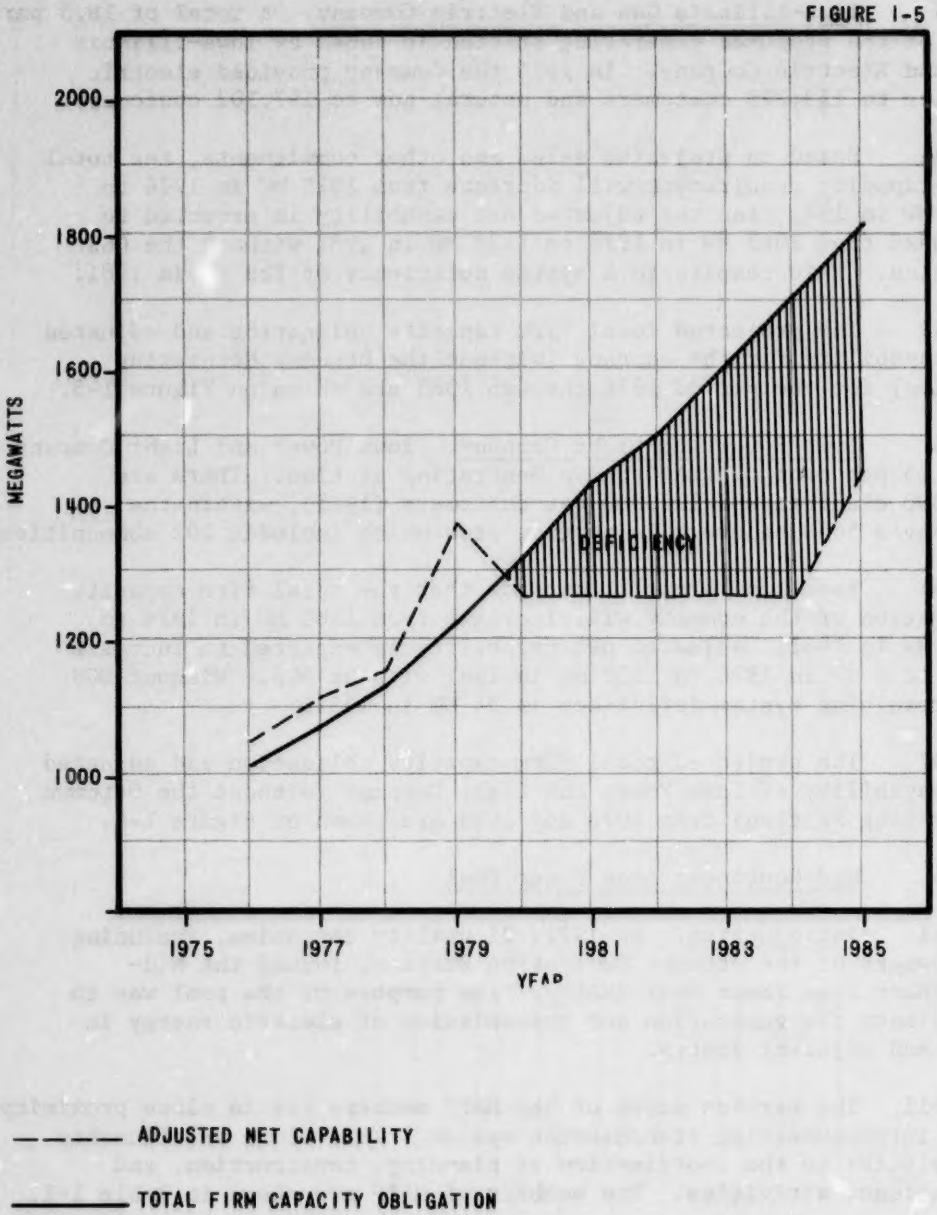
1.0252 The projected total firm capacity obligation and adjusted net capability of Iowa Power and Light Company (without the Ottumwa Generating Station) from 1976 and 1985 are shown on Figure 1-6.

1.026 Mid-Continent Area Power Pool.

1.0261 Introduction. In 1972, 21 utility companies, including the owners of the Ottumwa Generating Station, formed the Mid-Continent Area Power Pool (MAPP). The purpose of the pool was to coordinate the generation and transmission of electric energy in Iowa and adjacent states.

1.02611 The service areas of the MAPP members are in close proximity with interconnecting transmission system. This close relationship contributes to the coordination of planning, construction, and operational activities. The members of MAPP are shown in Table 1-2.

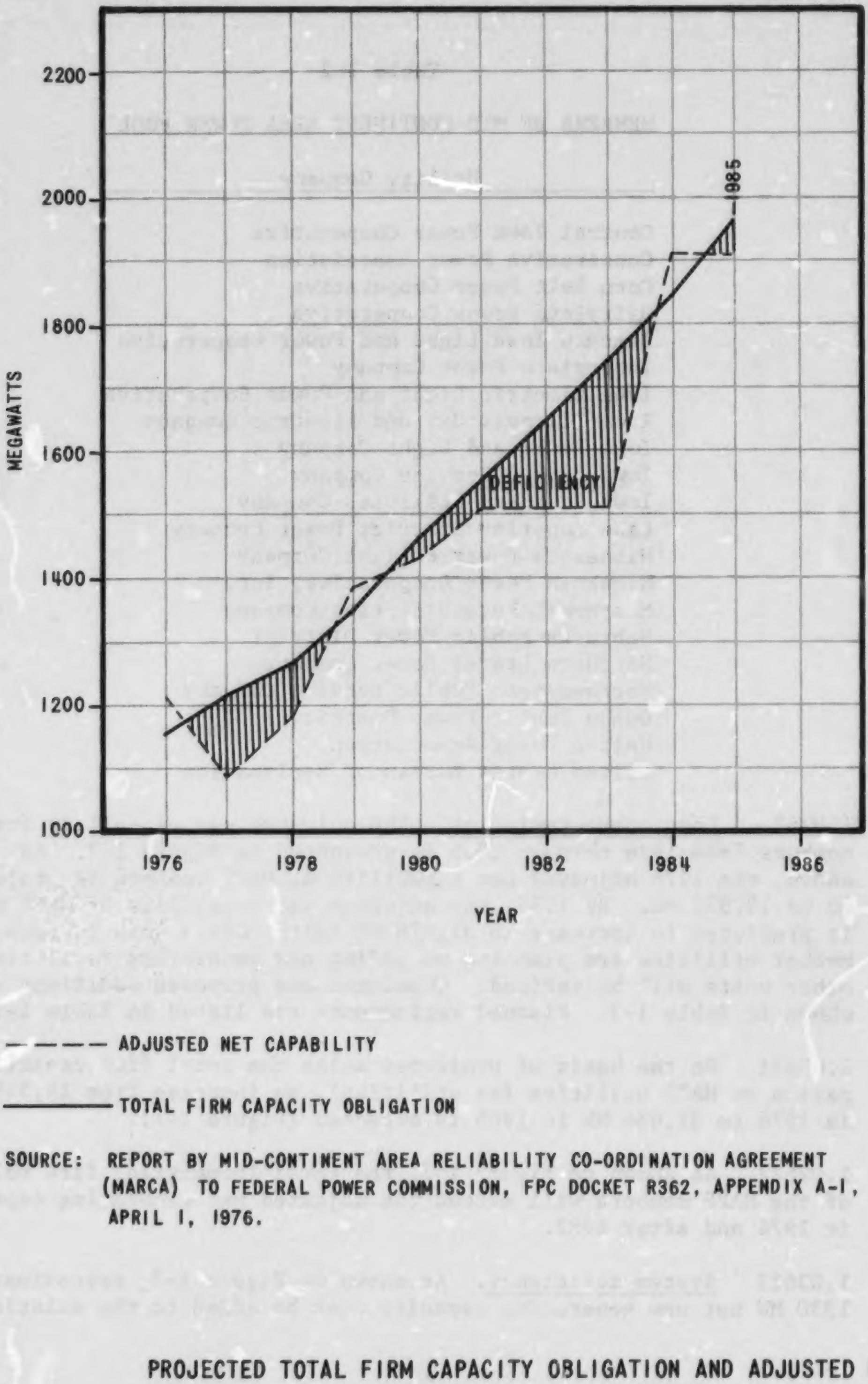
FIGURE I-5



SOURCE: REPORT BY MID-CONTINENT AREA RELIABILITY CO-ORDINATION AGREEMENT (MARCA) TO FEDERAL POWER COMMISSION, FPC DOCKET R362, APPENDIX A-I, APRIL I, 1976.

PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF IOWA-ILLINOIS GAS & ELECTRIC COMPANY - 1976-1985

FIGURE I-6



SOURCE: REPORT BY MID-CONTINENT AREA RELIABILITY CO-ORDINATION AGREEMENT (MARCA) TO FEDERAL POWER COMMISSION, FPC DOCKET R362, APPENDIX A-I, APRIL 1, 1976.

PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF IOWA POWER AND LIGHT COMPANY - 1976-1985

Table 1-2

MEMBERS OF MID-CONTINENT AREA POWER POOL

Utility Company
Central Iowa Power Cooperative
Cooperative Power Association
Corn Belt Power Cooperative
Dairyland Power Cooperative
Eastern Iowa Light and Power Cooperative
Interstate Power Company
Iowa Electric Light and Power Cooperative
Iowa-Illinois Gas and Electric Company
Iowa Power and Light Company
Iowa Public Service Company
Iowa Southern Utilities Company
Lake Superior District Power Company
Minnesota Power & Light Company
Minnkota Power Cooperative, Inc.
Montana-Dakota Utilities Company
Nebraska Public Power District
Northern States Power Company
Northwestern Public Service Company
Omaha Public Power District
United Power Association
United States Bureau of Reclamation

1.0262 Load characteristics. The adjusted net capability for MAPP members from 1976 through 1985 is presented on Figure 1-7. As shown, the 1976 adjusted net capability of MAPP members is projected to be 19,872 MW. By 1985, the adjusted net capability of MAPP members is predicted to increase to 31,878 MW (with OGS). This is because member utilities are planning on adding new generating facilities and other units will be retired. Committed and proposed additions are shown in Table 1-3. Planned retirements are listed in Table 1-4.

1.02621 On the basis of projected sales the total firm capacity obligation of MAPP utilities (as utilities), an increase from 18,849 MW in 1976 to 32,638 MW in 1985 is expected (Figure 1-7).

1.02622 As shown on Figure 1-7, the total (committed) firm obligation of the MAPP members will exceed the adjusted net generating capability in 1978 and after 1982.

1.02623 System deficiency. As shown on Figure 1-7, approximately 1330 MW net new generating capacity must be added to the existing

Table I-3

PROJECTED ADDITIONS OF GENERATING CAPABILITIES OF THE MID-CONTINENT AREA POWER POOL, MEGAWATTS 1976-1985

System	Unit Name		Location		Unit Type	Summer Rating	Committed In-Service Date
NSP	Cornell	4	Cornell	WI	Hydro	1.00	1976
LSDP	White River	1+2	Ashland	WI	Hydro	0.90	1976
IPS	Electrifarm	2	Waterloo	IA	Gas Turb	66.60	1977
ISP	Lansing	4	Lansing	IA	Fossil	260.00	1977
MPL	Milton R. Young	2	Center	ND	Fossil	408.00	1977
NSP	Sherburne Co.	2	Becker	MN	Fossil	680.00	1977
NWPS	Aberdeen Gt.	1	Aberdeen	SD	Gas Turb	22.00	1978
ISU	Burlington Gt.	1	Burlington	IA	Gas Turb	53.00	1978
IPS	Electrifarm	3	Waterloo	IA	Gas Turb	68.80	1978
NPPD	Gentleman	1	Sutherland	NE	Fossil	600.00	1978
BEPC	Clay County	1+2	Gayville	SD	Gas Turb	120.00	1978
CPA	Coal Creek (Share)	1	Underwood	ND	Fossil	254.00	1978
JPA	Coal Creek (Share)	1	Underwood	ND	Fossil	215.00	1978
IPL	Council Bluffs (Shr)	3	Council Bluffs	IA	Fossil	303.00	1979
IPS	Council Bluffs (Shr)	3	Council Bluffs	IA	Fossil	25.00	1979
EILP	Council Bluffs (Shr)	3	Council Bluffs	IA	Fossil	25.00	1979
IIGE	Council Bluffs (Shr)	3	Council Bluffs	IA	Fossil	211.00	1979
IELP	Council Bluffs (Shr)	3	Council Bluffs	IA	Fossil	50.00	1979
OPPD	Nebraska City	1	Nebraska City	NE	Fossil	575.00	1979
OPC	Alma	6	Alma	WI	Fossil	350.00	1979
ISP	Neal (Share)	4	Sioux City	IA	Fossil	100.00	1979
NWPS	Neal (Share)	4	Sioux City	IA	Fossil	50.00	1979
IPS	Neal (Share)	4	Sioux City	IA	Fossil	278.00	1979
UPA	Coal Creek (Share)	2	Underwood	ND	Fossil	215.00	1979
CPA	Coal Creek (Share)	2	Underwood	ND	Fossil	251.00	1979
MPL	Boswell	4	Cohasset	MN	Fossil	500.00	1980
NPPD	Gentleman	2	Sutherland	NE	Fossil	600.00	1980
IPS	Ottumwa (Share)	1	Chillicothe	IA	Fossil	125.00	1980
IPL	Ottumwa (Share)	1	Chillicothe	IA	Fossil	100.00	1980
ISU	Ottumwa (Share)	1	Chillicothe	IA	Fossil	325.00	1980
IIGE	Ottumwa (Share)	1	Chillicothe	IA	Fossil	125.00	1980
MPC	Coyote (Share)	1	Beulah	ND	Fossil	123.00	1981
MDU	Coyote (Share)	1	Beulah	ND	Fossil	82.00	1981
NWPS	Coyote (Share)	1	Beulah	ND	Fossil	41.00	1981
NSP	Sherburne Co.	3	Becker	MN	Fossil	800.00	1981
NPPD	Pumped Hydro	1	Lynch	NE	Hydro	166.67	1982
NPPD	Pumped Hydro	2	Lynch	NE	Hydro	166.67	1982
OPPD	Ft. Calhoun (Share)	2	Ft. Calhoun	NE	Nuclear	575.00	1983
NPPD	Ft. Calhoun (Share)	2	Ft. Calhoun	NE	Nuclear	575.00	1983
NPPD	Pumped Hydro	3	Lynch	NE	Hydro	166.67	1983
NPPD	Pumped Hydro	4	Lynch	NE	Hydro	166.67	1983
NPPD	Pumped Hydro	5	Lynch	NE	Hydro	166.67	1983
NPPD	Pumped Hydro	6	Lynch	NE	Hydro	166.67	1983
NSP	Sherburne Co.	4	Becker	MN	Fossil	800.00	1983
IPL	Central IA. (Share)	1	Central	IA	Nuclear	400.00	1984
MPC	P. R. Young (Share)	2	Center	ND	Fossil	120.00	1984
IIGE	Carroll (Share)	1	Carroll County	IL	Nuclear	165.00	1985
ISP	Carroll (Share)	1	Carroll County	IL	Nuclear	202.00	1985
DPC	Tyrone (Share)	1	Durand	WI	Nuclear	150.00	1985
CPA	Tyrone (Share)	1	Durand	WI	Nuclear	200.00	1985
NSP	Tyrone (Share)	1	Durand	WI	Nuclear	800.00	1985
IELP	1978 Gt.	1		IA	Gas Turb	150.00	1978 Addition
NWPS	Mitchell Gt.	1	Mitchell	SD	Gas Turb	22.00	1980 Addition
BEPC	Laramie River (Shr)	2	Wheatland	WY	Fossil	11.00	1980 Addition
MPL	Coyote (Share)	1	Beulah	ND	Fossil	20.50	1981 Addition
BEPC	Beulah	1	Beulah	ND	Fossil	400.00	1981 Addition
BEPC	Beulah	2	Beulah	ND	Fossil	400.00	1982 Addition
MPL	Brookston	1	Brookston	MN	Fossil	800.00	1984 Addition
IELP	Central IA. (Share)	1	Central	IA	Nuclear	300.00	1984 Addition

Source: Report by Mid-Continent Area Reliability Co-Ordination Agreement (MARCA) to Federal Power Commission, FPC Docket R362, Appendix A-1, April 1, 1976.

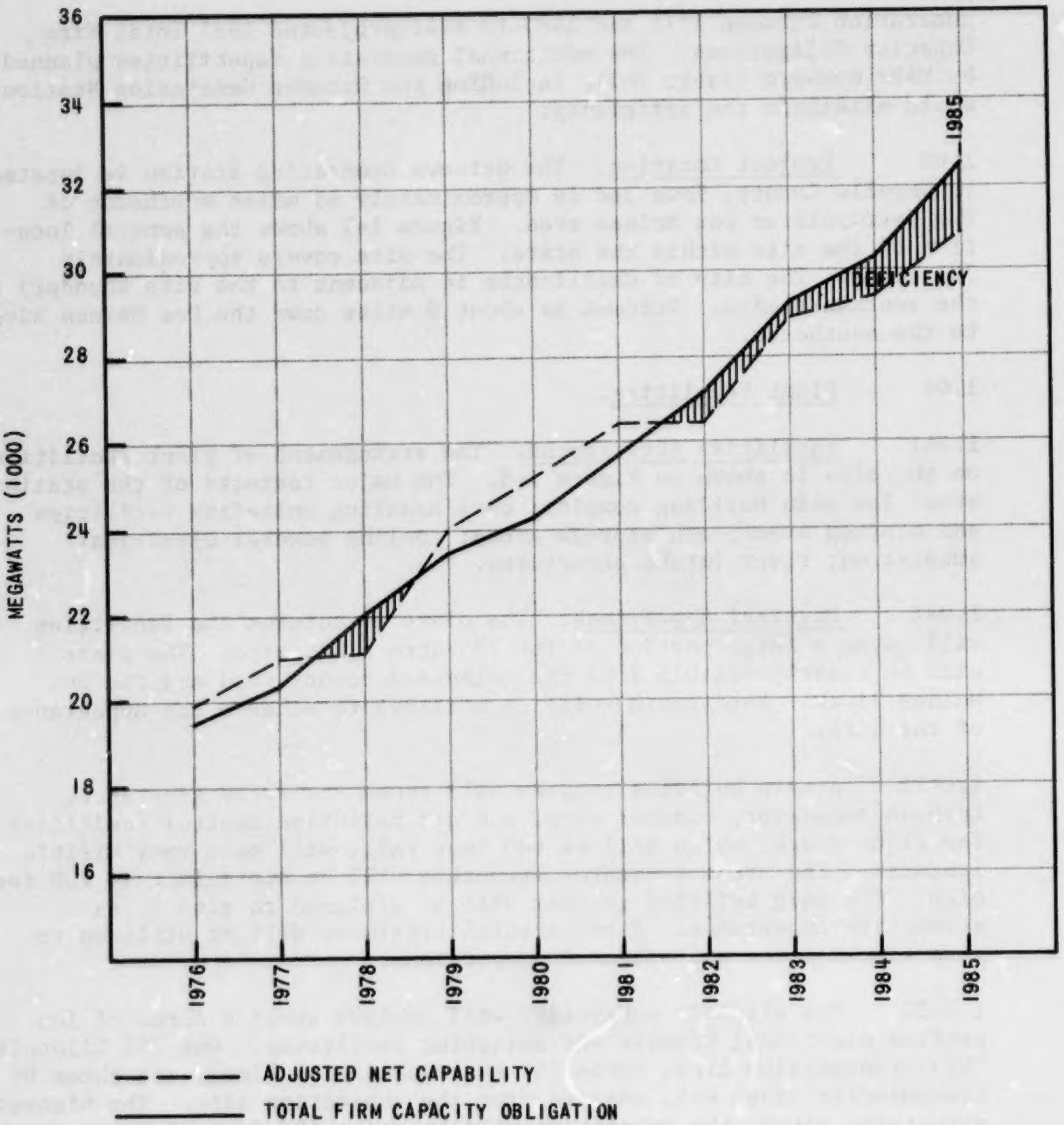
Table 1-4

PROJECTED RETIREMENTS OF GENERATING CAPABILITIES
OF THE MID-CONTINENT AREA POWER POOL, MEGAWATTS
1976-1985

System	Unit Name		Location		Unit Type	Summer Rating	Committed In-Service Date	
IPS	Diesel			IA	Diesel	3.00	1976	Retirement
IPS	Maynard	4+5	Waterloo	IA	Fossil	23.20	1976	Retirement
IPS	Diesel			IA	Diesel	6.00	1978	Retirement
IPS	Diesel			IA	Diesel	3.00	1979	Retirement
IPS	Kirk	1+5	Sioux City	IA	Fossil	18.50	1979	Retirement
IPS	Carroll	1+2	Carroll	IA	Fossil	10.61	1981	Retirement
IPS	Diesel			IA	Diesel	2.00	1981	Retirement
IPS	Eagle Grove	1	Eagle Grove	IA	Fossil	9.84	1981	Retirement
IPS	Hawkeye	1+2	Storm Lake	IA	Fossil	22.79	1981	Retirement
NSP	French Island	1+2	Lacrosse	WI	Fossil	28.00	1982	Retirement
NSP	Red Wing	1+2	Red Wing	MN	Fossil	15.00	1982	Retirement
NSP	Various Diesels		Various Locations		Diesel	13.00	1982	Retirement
NSP	Wilmarth	1+2	Mankato	MN	Fossil	25.00	1982	Retirement
NSP	Various Diesels		Various Locations		Diesel	7.00	1983	Retirement
NSP	High Bridge	3+4	St. Paul	MN	Fossil	98.00	1984	Retirement
NSP	Riverside	1+2+6	Minneapolis	MN	Fossil	105.00	1984	Retirement
NWPS	Aberdeen	2	Aberdeen	SD	Fossil	4.50	1976	Retirement
IPS	Dickens	1+2	Dickens	IA	Diesel	2.60	1976	Retirement
IPS	Galbraith	1+2	Galbraith	IA	Diesel	2.60	1976	Retirement
NWPS	Mitchell	2	Mitchell	SD	Fossil	3.90	1976	Retirement
IPS	Sherwood	1+2	Sherwood	IA	Diesel	2.55	1976	Retirement
IIGE	Riverside	1	Bettendorf	IA	Fossil	23.85	1977	Retirement
USBR	Capacity Conversion		To Adverse Water		Hydro	54.00	1977	Derate
IIGE	Moline	M-3	Moline	IL	Fossil	13.52	1977	Retirement
IELP	Sixth Street		Cedar Rapids	IA	Fossil	1.00	1977	Derate
MDU	McBridge	2	McBridge	SD	Fossil	8.50	1977	Retirement
IPS	Dinsdale	1+2	Dinsdale	IA	Diesel	3.00	1977	Retirement
NSP	Lawrence	1-3	Sioux Falls	SD	Fossil	49.00	1977	Retirement
NSP	Black Dog	1-4	Minneapolis	MN	Fossil	62.00	1978	Derate
USBR	Capacity Conversion		To Adverse Water		Hydro	47.00	1978	Derate
NSP	Granite City	2+4	St. Cloud	MN	Gas Turb	2.00	1978	Derate
NSP	High Bridge	3-6	St. Paul	MN	Fossil	31.00	1978	Derate
NSP	Key City	2+4	Mankato	MN	Gas Turb	2.00	1978	Derate
NSP	Minnesota Valley	3	Granite Falls	MN	Fossil	1.00	1978	Derate
NSP	Red Wing	1+2	Red Wing	MN	Fossil	3.00	1978	Derate
NSP	Riverside	1+2+6	Minneapolis	MN	Fossil	45.00	1978	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1978	Derate
NSP	West Faribault	3	Faribault	MN	Gas Turb	1.00	1978	Derate
NSP	Wilmarth	1+2	Mankato	MN	Fossil	3.00	1978	Derate
NWPS	Aberdeen	3	Aberdeen	SD	Fossil	7.80	1978	Retirement
NWPS	Mitchell	3	Mitchell	SD	Fossil	8.50	1978	Retirement
USBR	Capacity Conversion		To Adverse Water		Hydro	20.00	1979	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1979	Derate
NPPD	K Street	3	Lincoln	NE	Fossil	18.00	1979	Retirement
USBR	Capacity Conversion		To Adverse Water		Hydro	20.00	1980	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1980	Derate
BEPC	William J. Neal		Voltaire	ND	Fossil	35.00	1980	Retirement
USBR	Capacity Conversion		To Adverse Water		Hydro	10.00	1981	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1981	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1982	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1983	Derate
MPC	Warroad	1+2+5	Warroad	MN	Diesel	2.30	1983	Retirement
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1984	Derate
MPL	Milton R. Young	2	Center	ND	Fossil	120.00	1984	Derate
IELP	Sixth Street		Cedar Rapids	IA	Fossil	0.50	1985	Derate

Source: Report by Mid-Continent Area Reliability Co-Ordination Agreement (MARCA) to Federal Power Commission, FPC Docket R362, Appendix A-1, April 1, 1976.

FIGURE I-7



SOURCE: REPORT, MID-CONTINENT AREA RELIABILITY CO-ORDINATION AGREEMENT (MARCA) TO THE FEDERAL POWER COMMISSION PURSUANT TO FPC DOCKET R-362, APPENDIX A-1, APRIL 1, 1975

PROJECTED TOTAL FIRM CAPACITY OBLIGATION AND ADJUSTED NET CAPABILITY OF MID-CONTINENT AREA POWER POOL MEMBERS generation between 1976 and 1985 to meet projected 1985 Total Firm Capacity Obligations. The additional generating capabilities planned by MAPP members (Table 1-3), including the Ottumwa Generating Station, would eliminate the deficiency.

1.03 Project Location. The Ottumwa Generating Station is located in Wapello County, Iowa and is approximately 65 miles southeast of the metropolitan Des Moines area. Figure 1-1 shows the general location of the site within the state. The site covers approximately 795 acres. The city of Chillicothe is adjacent to the site boundary on the southeast edge. Ottumwa is about 8 miles down the Des Moines River to the southeast.

1.04 Plant Facilities.

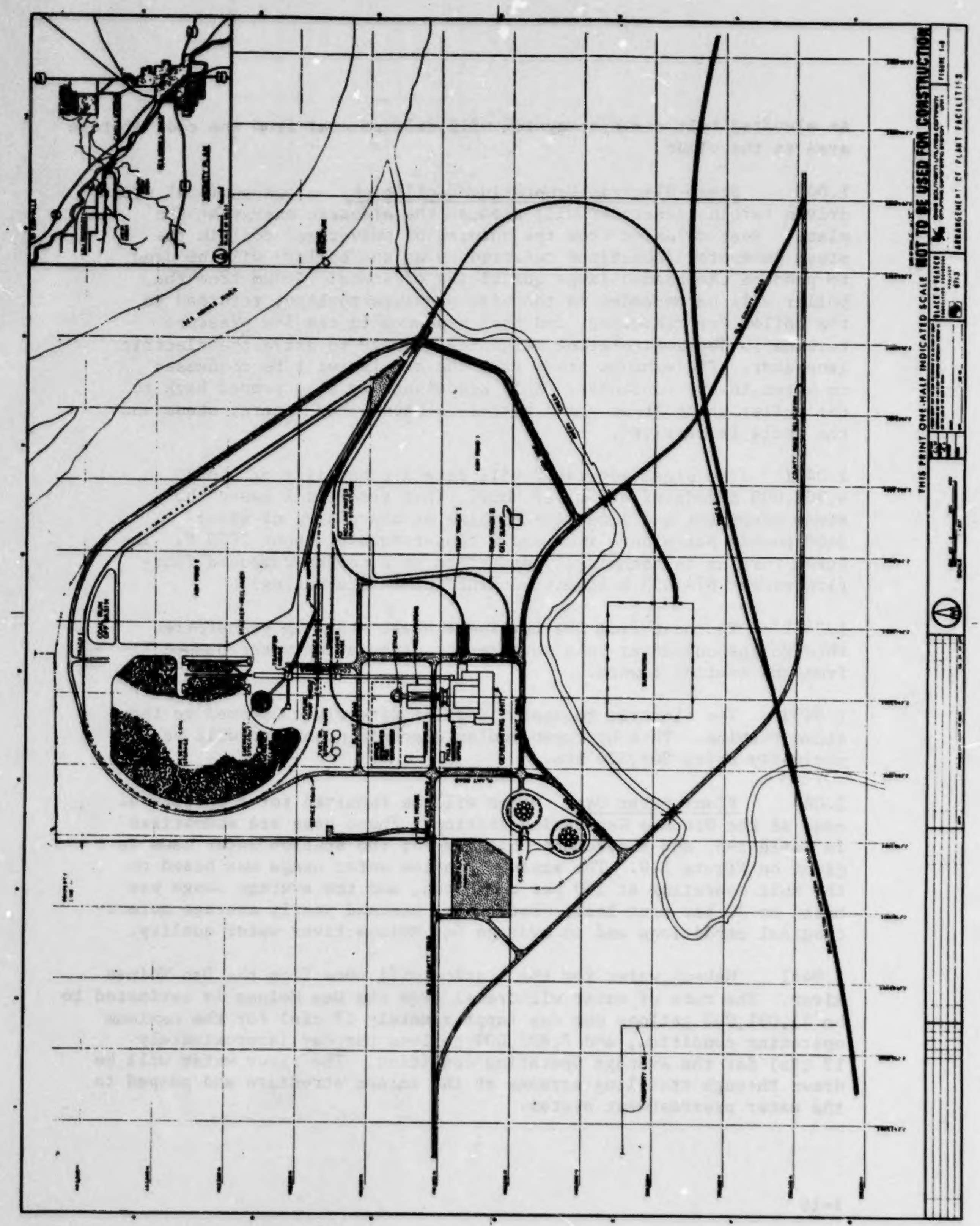
1.041 Facilities Arrangement. The arrangement of plant facilities on the site is shown on Figure 1-8. The major features of the station are: The main building complex; coal handling unloading facilities and storage areas; ash storage areas; cooling towers; electrical substation; river intake structures.

1.042 Physical Appearance. The plant structures and facilities will cover a large portion of the 795-acre plant site. The plant will be clearly visible from the relocated county road and the Des Moines River. Landscaping will be utilized to enhance the appearance of the site.

1.0421 A main building complex will house the steam generator, turbine generator, control room, and air pollution control facilities. The plant stack, which will be 600 feet tall, will be a very visible landmark. The steam generator structure will be approximately 250 feet high. The main building complex will be designed to give it an attractive appearance. Architectural treatment will be utilized to give simple lines and balanced proportions.

1.0422 The electric substation will include about 6 acres of low profile electrical buswork and switching facilities. One 345 kilovolt (kV) transmission line, three 161 kV transmission lines, and three 69 kV transmission lines will emanate from the substation site. The highest structures within the substation will be about 100 feet high and the highest transmission line structures will be about 125 feet high.

1.0423 The area east and northeast of the main building complex will be used for the ash storage containments. These containments will be earthen embankments with gradual slopes. Maximum embankment height will be approximately 30 feet above grade. The coal storage area will utilize the area north of the main building complex. Coal in the inactive storage area will be compacted and stored to a 40-foot depth.


THIS PRINT ONE-HALF INDICATED SCALE
NOT TO BE USED FOR CONSTRUCTION
BLACK & VEATCH
FIGURE 1-8
ARRANGEMENT OF PLANT FACILITIES
GENERATING UNIT
PLANT ROAD

An elevated belt conveyor system will deliver coal from the coal storage area to the plant.

1.043 Steam Electric Generating Facilities. A conventional steam driven turbine generator will produce the electric energy at the plant. Heat released from the burning of pulverized coal in the steam generator (sometimes referred to as the boiler) will be used to produce the needed large quantities of steam. Steam from the boiler will be expanded in the high pressure turbine, returned to the boiler for reheating, and then expanded in the low pressure turbine to develop rotating mechanical energy to drive the electric generator. The exhaust steam from the turbine will be condensed to water in the condenser. This condensate is then pumped back to the boiler where it is again heated to become high energy steam and the cycle is repeated.

1.0431 The steam generator will have a capability of about 4,900,000 pounds of steam per hour. That steam will leave the steam generator and enter the turbine at a pressure of about 2400 pounds per square inch and a temperature of about 1000 F. The steam turbine is technically described as a tandem-compound four-flow reheat 674,453 kilowatt machine (nameplate rating).

1.0432 The heat from the turbine exhaust steam is transferred through the condenser tube surfaces to circulating water pumped from the cooling towers.

1.0433 The electric generator will be directly connected to the steam turbine. This hydrogen-cooled electric generator will be a nominally rated 806,500 kVA.

1.044 Plant Water Use. Water will be required for a variety of uses at the Ottumwa Generating Station. These uses are summarized in Table 1-5, and a schematic diagram for the station water uses is given on Figure 1-9. The maximum station water usage was based on the unit operating at 100 per cent load, and the average usage was based on 70 per cent load. Both cases assumed yearly average meteorological conditions and an average Des Moines River water quality.

1.0441 Makeup water for the station will come from the Des Moines River. The rate of water withdrawal from the Des Moines is estimated to be 11,091,000 gallons per day (approximately 17 cfs) for the maximum operating condition, and 7,802,000 gallons per day (approximately 12 cfs) for the average operating condition. The river water will be drawn through traveling screens at the intake structure and pumped to the water pretreatment system.

TABLE 1-5

WATER MASS BALANCE
FLOW TABULATIONS*

Stream No.	Description	Maximum Conditions 100% Load Factor (x 10^3 gpd)	Average Conditions 70% Load Factor (x 10^3 gpd)
1	Total River Water Makeup	11,127	7,834
2	Basin Makeup	0	0
3	Water Pretreatment System Makeup	11,127	7,834
4	Gravity Filter Makeup	383	309
5	Gravity Filter Backwash Wastes	3	3
6	Solids Contact Basin Blowdown	130	92
7	Water Pretreatment Sump Effluent	133	95
8	Circulating Water Makeup	10,614	7,433
9	Cooling Tower Evaporation & Drift	10,028	7,026
10	Total Circulating Water Blowdown	694	479
11	Circulating Water Pumps Bearing Water	108	72
12	Ash Sluicing Surge Tank Makeup††	0	0
13	Potable Water for Miscellaneous Plant Uses	36	36
14	Miscellaneous Wastes to Plant Drains	33	33
15	Miscellaneous Plant Drains Discharge	59	53
16	Sanitary Facilities Wastes	3	3
17	Sewage Treatment Plant Effluent	3	3
18	Makeup to Sodium Softeners	164	126
19	Wastes from Sodium Softeners	3	3
20	Makeup to Flash Evaporator	161	123
21	Flash Evaporator Blowdown	23	17
22	Makeup to Steam Cycle	138	106
23	Condensate Polishers Regeneration Wastes	5	5
24	Chemical Cleaning Wastes†	0	0
25	Condensate to Condensate Polishers	7,160	5,015
26	Polished Condensate Returned to Condenser	7,155	5,010
27	Soot Blowing and Miscellaneous Steam Losses	80	64
28	Steam Generator Blowdown	53	37
29	Rainfall Runoff From Roof & Yard Drains	167	167
30	Makeup to Ash Sluicing Surge Tank	2,696	1,894
31	Makeup to Bottom Ash System	3,390	2,373
32	Evaporation from Bottom Ash System	288	202
33	Ash Water Returned to Bottom Ash Basin	3,174	2,243
34	Hopper Seal Water	72	72
35	Ash Water Pit Effluent	53	37
36	Fly Ash Basin Makeup	0	0
37	Coal Pile Runoff Basin Discharge to River	53	53
38	Rainfall on Fly Ash Basin	92	92
39	Evaporation from Fly Ash Basin	92	92
40	Rainfall on Bottom Ash Basin	101	101
41	Evaporation from Bottom Ash Basin	110	110
42	Final Discharge to Des Moines River	889	700
43	Bottom Ash Basin Makeup**	0	0

TABLE 1-5 (CONT'D)

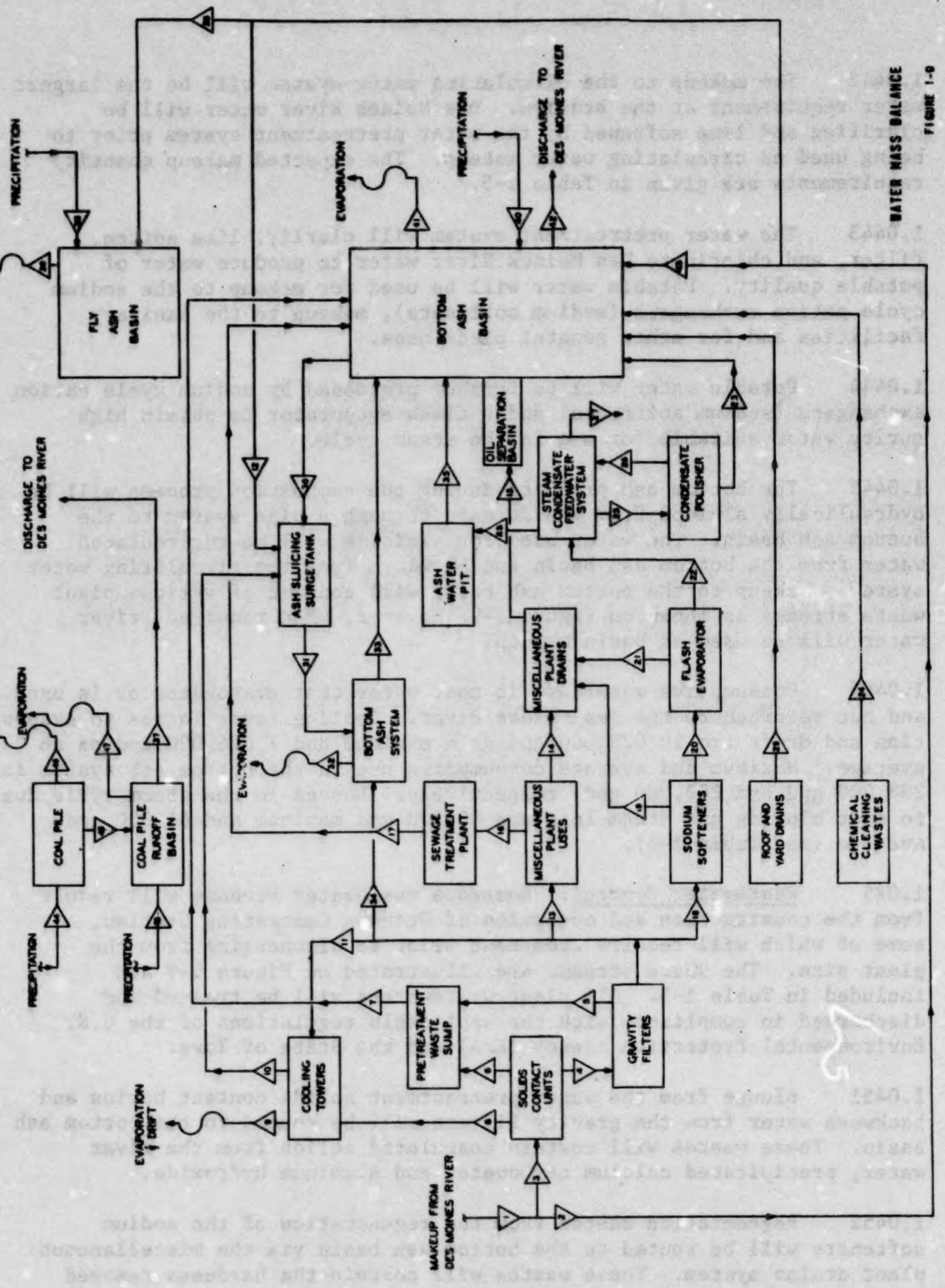
Stream No.	Description	Maximum Conditions 100% Load Factor (x 10^3 gpd)	Average Conditions 70% Load Factor (x 10^3 gpd)
44	Rainfall on Coal Pile	92	92
45	Coal Pile Runoff	51	51
46	Evaporation from Coal Pile	41	41
47	Evaporation from Coal Pile Runoff Basin	6	6
48	Rainfall on Coal Pile Runoff Basin	8	8

* The flows stated are based on yearly averages, and as such may not be the expected normal or maximum flows and should not be used for equipment design.

** This stream will be zero flow except in the case where makeup to the bottom ash basin is required.

† Chemical cleaning will occur prior to initial operation and then every two to five years afterwards.

†† Provisions for routing river water to the ash sluicing surge tank during plant start-up will be provided.



WATER MASS BALANCE

FIGURE 1-8

1.0442 The makeup to the circulating water system will be the largest water requirement at the station. Des Moines River water will be clarified and lime softened by the water pretreatment system prior to being used as circulating water makeup. The expected makeup quantity requirements are given in Table 1-5.

1.0443 The water pretreatment system will clarify, lime soften, filter, and chlorinate Des Moines River water to produce water of potable quality. Potable water will be used for makeup to the sodium cycle cation exchangers (sodium softeners), makeup to the sanitary facilities and for other general plant uses.

1.0444 Potable water will be further processed by sodium cycle cation exchangers (sodium softeners) and a flash evaporator to obtain high purity water suitable for use in the steam cycle.

1.0445 The bottom ash produced during the combustion process will be hydraulically sluiced from the furnace through a pipe system to the bottom ash basin. The water used for sluicing will be recirculated water from the bottom ash basin and blowdown from the circulating water system. Makeup to the bottom ash basin will consist of various plant waste streams as shown on Figure 1-9; however, when required, river water will be used as basin makeup.

1.0446 Consumptive water use is that water that evaporates or is used and not returned to the Des Moines River. Cooling tower losses to evaporation and drift are 10,028,000 gpd as a maximum and 7,026,000 gpd on an average. Maximum and average consumptive use in the bottom ash system is 288,000 gpd and 202,000 gpd, respectively. Losses in the steam cycle due to soot blowing and steam loss are 80,000 gpd maximum and 64,000 gpd average (see Table 1-5).

1.045 Wastewater Control. Numerous wastewater streams will result from the construction and operation of Ottumwa Generating Station, some of which will require treatment prior to discharging from the plant site. The waste streams are illustrated on Figure 1-9 and included in Table 1-5. All plant wastewaters will be treated and discharged in compliance with the applicable regulations of the U.S. Environmental Protection Agency (EPA) and the State of Iowa.

1.0451 Sludge from the water pretreatment solids contact basins and backwash water from the gravity filters will be routed to the bottom ash basin. These wastes will contain coagulated solids from the river water, precipitated calcium carbonate, and aluminum hydroxide.

1.0452 Regeneration wastes from the regeneration of the sodium softeners will be routed to the bottom ash basin via the miscellaneous plant drains system. These wastes will contain the hardness removed from the exchange resins plus any unreacted sodium chloride.

1.0453 The blowdown from the flash evaporator will have a high dissolved solids content and will be routed to the bottom ash basin, again via the miscellaneous plant drains system.

1.0454 Condensate polisher wastes will be routed to the bottom ash basin. These wastes will consist of solid filter media.

1.0455 Continuous removal of water (blowdown) is required for control of dissolved solids in the circulating water system. The blowdown will be discharged to the ash sluicing surge tank and used for bottom ash sluicing, prior to being discharged to the bottom ash basin. The blowdown will consist of pretreated river water concentrated approximately 15 times.

1.0456 The sanitary facilities wastes will be routed to a sewage treatment plant located on the Ottumwa site. The discharge from the sewage treatment plant will meet all regulatory discharge requirements and will be routed to the bottom ash basin.

1.0457 Miscellaneous plant drains include floor drains and various waste lines located throughout the station. These wastes are collected, routed through an oil-water separating basin and discharged to the bottom ash basin.

1.0458 The blowdown from the boiler will be routed to the bottom ash basin via the ash water pit.

1.0459 Bottom ash will be sluiced to the bottom ash basin by a hydraulic sluicing system utilizing blowdown from the circulating water system and recirculated water from the bottom ash basin. The bottom ash sluicing system waste streams will contain a high concentration of suspended solids which will settle out in the bottom ash basin.

1.04510 The fly ash will be handled dry and will be deposited under water in the fly ash basin for storage. The surface area of the fly ash basin will be approximately 34 acres.

1.04511 Rainfall runoff from the coal storage area will be to a runoff basin with a surface area of about 2.2 acres. This basin will be designed to contain the runoff from two consecutive 10-year, 24-hour rainfall events. Any discharge will be to the Des Moines River.

1.04512 The wastes resulting from preoperational chemical cleaning will be discharged to the bottom ash basin. This basin will allow the cleaning wastes to neutralize and suspended solids to settle prior to discharging from the plant site.

1.04513 The bottom ash basin will serve as a collection point for all plant waste streams and the plant yard and roof drains. The 40.5 acre basin will provide sufficient retention of wastewater to allow settling of suspended solids and equalization of pH. In this manner all non-consumptive wastewater from the station will be monitored and discharged to the Des Moines River from a single discharge point. This discharge will meet all the discharge requirements of the EPA and State of Iowa.

1.046 Sanitary Waste Disposal. A sewage treatment plant will treat the sewage produced during the operation of Ottumwa Generating Station. The treatment plant will serve approximately 60 employees along with any visitors or extra maintenance personnel at the plant site. During the construction phase, portable, self-contained sanitary facilities will be used to meet the additional sewage load. The sewage treatment plant will be a packaged, activated sludge unit of the extended aeration process type. The unit will include screening equipment, not less than 24-hour aeration tank, 4-hour clarification compartment, and sludge return and skimming facilities. The treatment plant will provide a sewage treatment capacity of approximately 10,000 gallons per day. A 90 per cent or greater BOD_5 (5-day biochemical oxygen demand) and suspended solids reduction will be achieved by the sewage treatment plant.

1.0461 The treated sewage will be discharged to the bottom ash basin where further reduction of suspended solids and BOD_5 will occur prior to discharging to the Des Moines River.

1.047 Circulating Water System. The circulating water system will provide cooling water to a surface condenser where exhaust steam from the turbine is condensed to water by transferring the residual heat energy to the circulating water. The circulating water passes through mechanical draft cooling towers where the residual heat is released to the atmosphere through evaporation and, to a lesser degree, by conduction. The circulating water system operates as a closed system by continuous recirculation of water between the condenser and the cooling towers. Because a portion of the circulating water is evaporated, makeup water is required. In addition, some water is also required to replace water which will be continuously removed from the cycle to maintain an acceptable dissolved solids concentration--so-called cooling tower "blowdown."

1.0471 The circulating water system will also provide cooling water to auxiliary cooling water systems.

1.0472 Makeup water for the circulating water system will be taken from the water pretreatment system. Water released from the circulating water system will be used in other plant systems, such as the ash disposal system, prior to storage and eventual release to the Des Moines River.

1.0473 Maximum circulating water system flow is estimated to be approximately 278,000 gallons per minute (gpm). Condenser requirements are approximately 248,000 gpm and auxiliary cooling water requirements are approximately 30,000 gpm. Makeup to the circulating water system may reach a short-term maximum of approximately 7500 gpm.

1.048 Fuel Supply, Transportation, and Utilization. Coal will be supplied from the Sunoco Energy Development Company's Cordero Mine in the Powder River Basin in Wyoming. The coal is subbituminous, characterized as low sulfur content with a heating value of about 1100 Btu per pound. A long-term contract has been signed with the supplier. An analysis of the coal is shown in Table 1-6.

1.0481 Specially designed unit trains will deliver coal to the plant site. Each train will have a capacity in excess of 10,000 tons. The 675,000 kilowatt unit will consume from 1.9 to 2.7 million tons of coal annually, depending on annual load factor. Approximately 175 to 250 trains a year or 3 to 5 per week, will be required to provide that amount of fuel.

1.0482 The coal cars will be unloaded and the coal will be delivered to either active or inactive storage or the plant silos. The active coal storage area will provide a supply of fuel for about 4 days operation. Inactive storage is required to provide a reserve supply of fuel on the plant site. Careful compaction of the inactive stored coal will be necessary to prevent spontaneous combustion. About 90 days supply of coal will be stored in the inactive storage area. Typical trace element concentrations of the coal and expected emissions from Ottumwa Generating Station are shown in Table 1-7.

1.0483 The coal stored in the active storage will be supplemented as new shipments of coal arrive. Similarly, coal will be reclaimed from active storage or directly from the railroad cars and transported with the elevated conveyor system to the coal silos adjacent to the steam generator. The coal must be crushed to a size about 2 inches or smaller before it is delivered to the silos. The coal then will be pulverized and burned in the boiler.

1.0484 A discussion concerning the selection of western coal for use at OGS and the alternate fuels considered is given in Section 6.04. Alternate modes of fuel transportation are discussed in Section 6.06.

1.049 Combustion Gases and Air Quality Control

1.0491 Introduction. The combustion of coal in the boiler furnace yields a large volume of gaseous and solid byproducts. Certain

TABLE 1-6

CORDERO MINE COAL ANALYSES

	Minimum	Maximum	Average
Proximate Analysis (144 Holes)			
Unweighted, 30.5% Moisture			
% Ash	4.51	13.13	6.10
% Volatile	26.71	33.92	30.55
% Fixed Carbon	23.78	34.96	32.47
% Chlorine	.01	.01	.01
% Sulfur	.15	.48	.32
Btu per pound	5643	8405	8110
Weighted by Tonnage, 30.5% Moisture			
% Moisture			30.50
% Ash			5.77
% Volatile			30.94
% Fixed Carbon			32.79
% Chlorine			.01
% Sulfur			.32
Btu per pound			8153
% Moisture, As Received	24.04	34.56	29.11
Dry Basis			
% Ash	6.48	18.89	8.77
% Volatile	38.43	48.81	43.95
% Fixed Carbon	34.21	50.30	46.71
% Chlorine	.01	.01	.01
% Sulfur	.22	.69	.46
Btu per pound	8119	12093	11669
Ultimate Analysis (104 Holes)			
30.5% Moisture			
% Ash	4.51	13.13	6.44
% Sulfur	.16	.49	.33
% Nitrogen	.34	1.01	.66
% Carbon	41.06	50.68	46.98
% Hydrogen	2.38	3.98	3.40
% Oxygen (Diff.)	9.66	14.05	12.67
% Chlorine	.01	.01	.01

TABLE 1-6 (CONT'D)

	Minimum	Maximum	Average
Dry Basis			
% Ash	6.48	18.89	9.26
% Sulfur	.23	.70	.47
% Nitrogen	.49	1.45	.95
% Carbon	59.08	72.93	65.60
% Hydrogen	3.43	5.73	4.89
% Oxygen (Diff.)	13.89	20.21	18.23
% Chlorine	.01	.01	.01
% Moisture	24.04	34.56	29.11
Ash Analysis (100 Holes)			
% Al_2O_3	9.70	21.92	16.82
% CaO	10.00	30.70	20.27
% K_2O	.16	1.44	.31
% MgO	.91	8.24	3.45
% Na_2O	.58	2.86	1.18
% SiO_2	17.00	59.71	35.58
% TiO_2	.64	2.21	1.13
% Fe_2O_3	1.95	8.35	4.75
% P_2O_5	.15	2.70	.89
% SO_3	4.24	17.95	11.17
Sulfur Forms (97 Holes)			
30.5% Moisture			
% Pyritic	.01	.22	.03
% Sulfate	.00	.10	.02
% Organic	.01	.43	.27
% Total Sulfur	.16	.49	.32
Dry Basis			
% Pyritic			.06
% Sulfate			.03
% Organic			.39
% Total Sulfur			.48
Water Soluble Alkalies (92 Holes)			
% Na_2O	.0129	.099	.056
% K_2O	.0004	.0098	.0046

TABLE 1-6 (CONT'D)

	Minimum	Maximum	Average
Fusion Temperature of Ash (102 Holes)			
Reducing Atmosphere			
Initial Deformation	1950	2318	2130
Softening (H=W)	2012	2336	2176
Hemispherical (H=1/2W)	2066	2354	2205
Fluid Temperature (FT)	2084	2372	2242
Oxidizing Atmosphere			
Initial Deformation (ID)	2084	2372	2204
Softening (H=W)	2102	2390	2247
Hemispherical (H=1/2W)	2138	2410	2276
Fluid Temperature (FT)	2192	2510	2312
Hardgrove Grindability Index (101 Holes)	47.0	80.0	59.1
Equilibrium Moisture (102 Holes)	21.32	27.95	24.86

TABLE 1-7

ANALYSIS OF TRACE ELEMENTS OF CORDERO COAL AND EXPECTED EMISSIONS FROM OTTUMWA GENERATING STATION

Element	Concentration in Coal ppm	Feed Rate[a] lb/hr	Per Cent Emitted %	Emission Rate ppm in Flue Gas[a]	Emission Rate[a] gm/sec	Emission Rate[a] lb/hr
Arsenic	1-4	0.86-3.4	100	0.04-0.16	0.11-0.43	0.86-3.4
Barium	51-190	43.9-163	0.48		0.03.0.1	0.21-0.78
Beryllium	0.1-0.8	0.085-0.69	0.48		0.0000054-0.0003	0.00004-0.003
Boron	9-37	7.7-31.8	97.8	2.45-10	0.95-3.9	7.5-31.15
Bromine	0.2-3.0	0.17-2.6	90	0.0066-0.1	0.019-0.295	0.15-2.34
Cadmium	0.4-1.0	0.35-0.86	0.48		0.0002-0.0006	0.0017 0.0048
Cerium	6-24	5.2-21.0	0.48		0.003-0.0126	0.025-0.1
Chlorine	22-186	18.9-160	90	0.23-5.63	0.295-7.1	2.34-56.5
Chromium	7-48	6.0-41.3	0.48		0.004-0.025	0.029-0.2
Cobalt	3-7	2.6-6.0	0.48		0.0015-0.0037	0.012-0.029
Copper	16-36	13.8-31.0	0.48		0.008-0.019	0.066-0.15
Fluorine	33-265	28.4-228	3	0.026-0.2	0.017-0.14	0.136-1.09
Gallium	5-13	0.86-11.2	0.48		0.025-0.007	0.02-0.054
Iodine	0.1-0.2	0.086-0.17	100	0.0024-0.0047	0.01-0.021	0.086-0.17
Iron	2740	2356	0.48		1.42	11.3
Lanthanum	4-10	3.4-8.6	0.48		0.002-0.005	0.016-0.04
Lead	1-4	0.86-3.4	0.48		0.0005-0.002	0.004-0.016
Lithium	0.4-3.0	0.34-2.6	0.48		0.0002-0.0015	0.0016-0.012

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[a] Based on a coal feed rate of 859,806 #/hr

TABLE 1-7 (CONT'D)

Element	Concentration in Coal ppm	Feed Rate[a] lb/hr	Per Cent Emitted %	Emission Rate ppm in Flue Gas[a]	Emission Rate[a] gm/sec	Emission Rate[a] lb/hr
Manganese	6-33	5.2-28.4	0.48		0.003-0.018	0.025-0.14
Mercury	0.03-0.19	0.25-0.16	9-70	0.000039-0.0019	0.0003-0.014	0.00225-0.11
Molybdenum	3-13	2.6-11.2	0.48		0.0015-0.0068	0.012-0.054
Neodymium	0.5-2.0	0.43-1.7	0.48		0.00025-0.001	0.002-0.0082
Nickel	5-14	4.3-12.0	0.48		0.0025-0.0073	0.02-0.058
Niobium	1-5	0.86-4.3	0.48		0.0005-0.0026	0.004-0.021
Praseodymium	0.2-1.0	0.17-0.86	0.48		0.0001-0.0005	0.0008-0.004
Rubidium	1-19	0.86-16.3	6	0.002-0.04	0.0063-0.12	0.05-0.98
Samarium	0.4-1.0	0.35-0.86	0.48		0.0002-0.0005	0.0017-0.004
Selinium	0.2-0.7	0.17-0.6	91.8	0.007-0.025	0.02-0.0076	0.16-0.55
Strontiom	130-275	112-236	0.48		0.068-0.14	0.54-1.13
Thorium	2-3	1.7-26	0.48		0.0001-0.0015	0.008-0.0012
Tin	0.4-0.8	0.35-0.69	0.48		0.0002-0.00042	0.0017-0.0033
Titanium	355-630	305-542	0.48		0.174-5.8	1.38-46.6
Uranium	2-3	1.7-2.6	0.48		0.0001-0.0015	0.008-0.012
Vanadium	14-54	12-46.4	0.48		0.0075-0.03	0.06-0.22
Yittrium	5-23	4.3-19.8	0.48		0.0025-0.0126	0.02-0.1
Zinc	5-23	4.3-19.8	0.48		0.0025 0.012	0.02-0.095
Zirconium	11-53	9.45-45.6	0.48		0.0057-0.028	0.045-0.22

constituents of combustion byproduct gases are designated air pollutants. The discharge to the atmosphere of these air pollutants is subject to specific regulatory limitations. Various measures will be utilized to control the emission of air pollutants to ensure that emission rates and resulting ground level pollutant concentrations are within regulatory limits.

1.04911 Calculations show that 1,900,000 scfm (at 77 F and 29.92 inches of mercury) of gaseous wastes will result from operation of the boiler at maximum capability. These gases will generally include the constituents shown in Table 1-8. The amounts of the constituents present depend upon the particular fuel burned and specific operating conditions. Among the constituents, particulate matter as well as the oxides of sulfur and oxides of nitrogen are designated air pollutants and their discharge to the atmosphere is subject to limitations established by federal and Iowa regulatory authorities. Carbon monoxide and unburned hydrocarbons also are regulated and they will be emitted from the generating station. Their concentrations will be so low, however, that they will have an insignificant effect on air quality.

Table 1-8

COMBUSTION GAS CONSTITUENTS

Nitrogen
Carbon Dioxide
Water Vapor
Oxygen
Sulfur Dioxide
Nitrogen Dioxide
Carbon Monoxide
Unburned Hydrocarbons
Particulate Matter

1.0492 Air pollution control system. Emissions of nitrogen oxides, sulfur oxides, and particulate matter are limited by equipment design, fuel selection, and the use of control equipment. Atmospheric discharges from a tall stack will limit ground level concentrations. A detailed discussion of expected ambient air concentrations is given in Section 4.02. The following measures described will achieve the degree of air pollutant discharge control required by regulatory standards.

1.04921 Nitrogen oxide control. The control of nitrogen oxide emissions will be achieved by furnace design. Steam generator specifications obligate the manufacturer to guarantee nitrogen oxide emission rates below the level specified by regulatory standards.

Control of the combustion process in the furnace is the best known method for limiting nitrogen oxide emissions.

1.04922 Sulfur oxide control. Sulfur oxide emissions will be minimized by fuel selection. Low sulfur, subbituminous western coal has been selected as the plant fuel supply. The coal supply contract specifies the maximum acceptable sulfur content at a level low enough to assure compliance with all applicable sulfur dioxide emission standards. Space has been allotted for the installation of sulfur oxide removal equipment should low sulfur coal not be available at some future date.

1.04923 Particulate matter control. Particulate matter emissions will be controlled by the use of an electrostatic precipitator. This precipitator will be designed and guaranteed to remove not less than 99.4 per cent of the particulate matter from the combustion gas stream or produce a dust loading at the outlet of the precipitator of not more than 0.0005 grains per acfm, whichever is least stringent. The efficiency has been specified at this level so as to meet all applicable particulate matter emission standards including regulations applicable to visible emissions.

a. The precipitator will be designed to achieve sustained design efficiency over its lifetime. The precipitator, hoppers, inlet and outlet plenums, and ductwork will be heavily insulated to minimize heat loss and corrosion. The rapping system will be designed and field adjusted so that rapping impulses are delivered to both the emitting and collecting electrodes as required for sustained high efficiency operation without dust re-entrainment.

b. The combustion gases will be discharged to the atmosphere from a tall plant stack after leaving the electrostatic precipitator. The stack will be 600 feet in height and will provide good dispersion of the gases.

1.04924 Trace Elements. The expected emission concentrations of trace element are as shown in Table 1-7. A discussion of expected ambient air concentrations is given in Section IV, page 4-18.

1.0493 Ash Handling And Storage System. Ash will be produced at a rate of about 28 tons per hour when the steam generator is operating at maximum capability and firing the typical coal that is representative of the fuels that will be burned. This ash will consist of about 90 per cent fly ash and about 10 per cent bottom ash.

1.04931 The fly ash will be entrained in the flue gas and collected in the electrostatic precipitator. The bottom ash, consisting of ash particles heavier than fly ash, will remain in the steam generator furnace and be collected in hoppers located below the furnace area.

1.04932 All ash will be stored in the ash disposal areas located east of the main generating complex as shown on Figure 1-8. Adjacent, but separate, storage areas will be provided for bottom ash and fly ash. The earthen embankments that form the storage containments will be of sufficient height to prevent the entrance of flood waters.

1.04933 The bottom ash collected in the furnace bottom hoppers will be sluiced through a piping system to the bottom ash disposal area by means of hydraulic ejectors. After the bottom ash settles in the disposal area, the sluice water will be recycled for bottom ash sluicing.

1.04934 Moistened fly ash from the western subbituminous coal will harden to form a solid material. For this reason, fly ash will be handled in a dry state. The fly ash collected in the precipitator will be transported by pneumatic transport system to fly ash storage silos. Fly ash will be trucked from the silos to the fly ash pond. The fly ash will be pneumatically unloaded at the fly ash pond under water. Off-site storage of fly ash will probably be necessary in the latter years of plant operation.

1.04935 Fly ash may have commercial value in the manufacture of cement or as an additive for concrete. If a market for the fly ash ever develops, the fly ash will be trucked from the storage silos to the point of use. The capacity of the fly ash disposal area could possibly be reduced if a substantial amount of fly ash could be marketed.

1.0494 Transmission Facilities. Three 161 kV circuits, and one 345 kV circuit will probably be required to transmit power from the Ottumwa Generating Station.

II ENVIRONMENTAL SETTING WITHOUT THE PROJECT

2.01 Geology

2.011 Introduction. This section is a summary of the regional and site geology present at Iowa Southern Utilities Ottumwa Generating Station based on available literature and field investigations represented by on-site borings. Regional Geology includes a discussion of the physiography, stratigraphy, and structural features present in southeastern Iowa. Estimates of predicted earthquake intensity (Modified Mercalli) for the site are presented in Seismology. The Site Geology subsection summarizes the characteristics of surficial deposits and consolidated bedrock beneath the site area.

2.012 Regional Geology

2.0121 Physiography. The Ottumwa Generating Station site, is located primarily north of Middle Avery Creek on an erosional terrace southwest of the flood plain of the Des Moines River in Wapello County. The county lies in the Dissected Till Plains of the Central Lowlands physiographic province. This subprovince exhibits a greater degree of dissection and a general absence of end moraines, lakes, or lake plains in comparison to the other glaciated parts of the Central Lowlands. The topographic relief was developed by a post-glacial, well-integrated drainage system upon the nearly level Kansan age till plain.

2.01211 The till plain has a gentle slope to the southeast which is paralleled by the flow of the major streams.

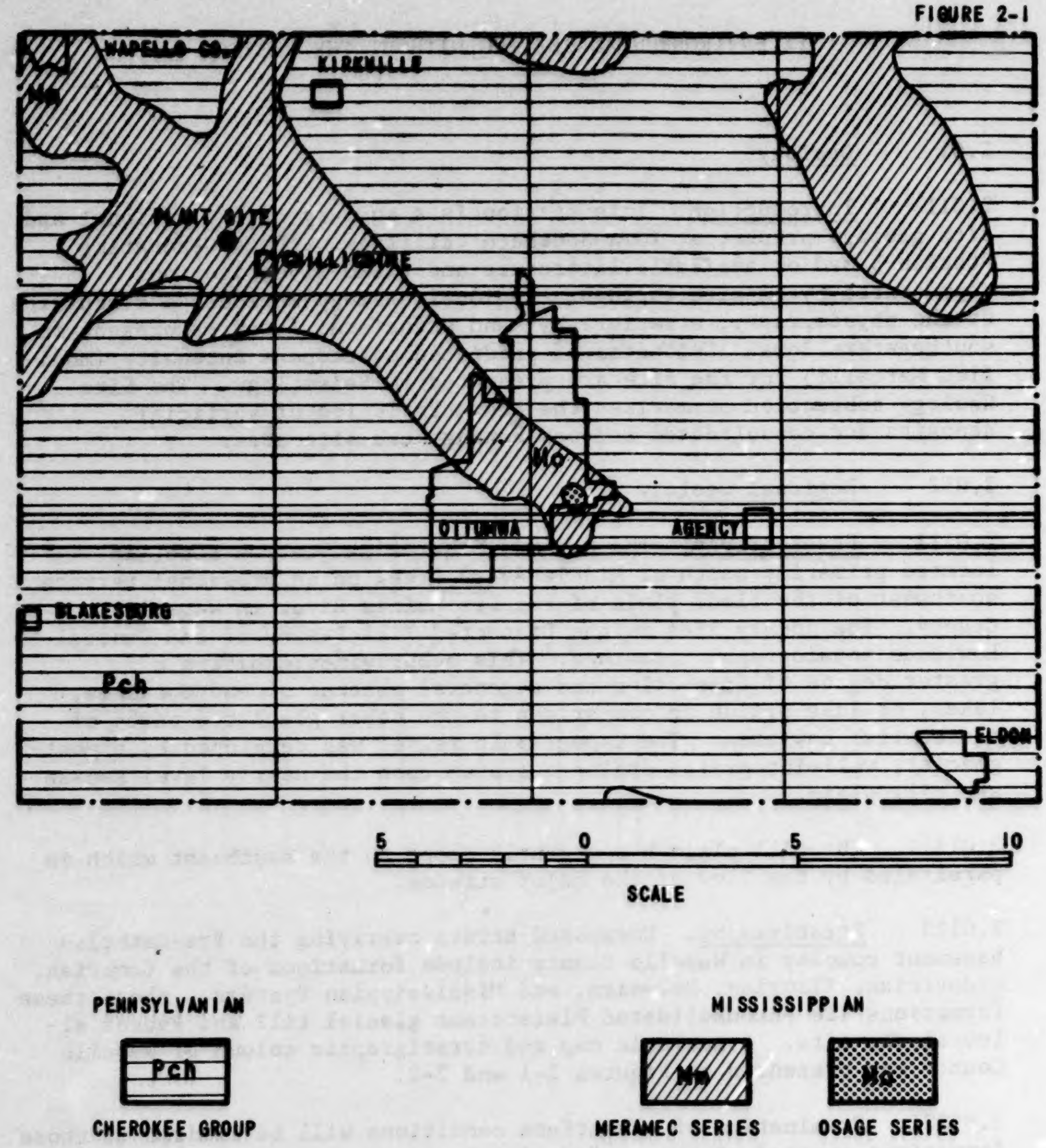
2.0122 Stratigraphy. Unexposed strata overlying the Pre-Cambrian basement complex in Wapello County include formations of the Cambrian, Ordovician, Silurian, Devonian, and Mississippian Systems. Above these formations lie unconsolidated Pleistocene glacial till and Recent alluvial deposits. A geologic map and stratigraphic column of Wapello County are presented on Figures 2-1 and 2-2.

2.01221 Examination of subsurface conditions will be limited to those formations exposed at the surface in the county.

2.0123 Paleozoic era. Two Paleozoic systems are represented at the surface in Wapello County, the Mississippian and the Pennsylvanian.

2.01231 Mississippian age rocks are believed to have been deposited in warm shallow seas which fluctuated somewhat in geographic extent. The oldest rocks exposed in the county belong to the Osage Series, the

FIGURE 2-1



SOURCE: IOWA GEOLOGICAL SURVEY MISCELLANEOUS MAP SERIES 4, 1973.

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BEDROCK GEOLOGY OF WAPELLO COUNTY

FIGURE 2-2

PENNSYLVANIAN SYSTEM	DES MOINESIAN SERIES	CHEROKEE GROUP	CYCLIC DEPOSITS WITH CARBONACEOUS SHALE, CLAY, SILTSTONE, SANDSTONE THICK COAL BEDS AND MINOR, BUT PERSISTENT LIMESTONE BEDS.
MISSISSIPPIAN SYSTEM	MERAMECIAN SERIES		STE. GENEVIEVE FORMATION
			ST. LOUIS FORMATION
			SPERGEN FORMATION
	OSAGEAN SERIES		WARSAW FORMATION
			KEOKUK LIMESTONE
			BURLINGTON LIMESTONE

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

GENERALIZED STRATIGRAPHIC COLUMN OF THE MISSISSIPPIAN AND PENNSYLVANIAN IN WAPELLO COUNTY upper middle series in the Mississippian System. This series consists of fossiliferous, gray to brown limestones and dolomites, white, gray, and brown chert, and two widespread glauconite zones in its upper portion. Stratigraphically overlying the Osage is the Meramec Series consisting of three units which in ascending order are: a sandy, micaceous dolomite; a limestone and dolomite sequence, with locally dominant sandstone and occasional concentrations of chert; and a fossiliferous limestone with red and green shale.

2.01232 The Pennsylvanian rocks were deposited in eastern Iowa as part of a great delta extending southwestward from across Illinois. The Cherokee Group of the Des Moines Series represents the oldest Pennsylvanian rocks in Wapello County. This group consists of alternating deposits of carbonaceous shale, clay, siltstone, sandstone, thick coal beds, and minor but persistent limestone beds.

2.0124 Cenozoic era. Southeastern Iowa was covered by the Kansan age glacial advance about 700,000 years ago. A thick blanket of glacial debris, including in some places a thin sheet of wind blown silt above the till, was deposited over the Mississippian and Pennsylvanian age bedrock. The drift sheet left by this advance consists of stratified and unstratified sand, silt, clay, pebbles, and boulders. In Wapello County these deposits vary thickness from about 25 to 170 feet, with the thinnest sections being found along the major drainageways.

2.01241 Windblown silt (loess) is found overlying the Kansan drift throughout most of the county, but is only dominant atop the highest uplands where it is around 5 feet thick and has not been removed by erosion.

2.01242 Recent alluvium is present as sand, silt, clay, and gravel in the flood plains of the Des Moines River and its tributaries. Remnants of older flood plains are recognized as terrace levels ranging from 8 to 50 feet above the present flood plain.

2.0125 Structural geology. Southeastern Iowa is situated in the Central Stable Region of the United States. It lies near the eastern edge of the Forest City Basin, a downwarped area with a northeast-southwest trending axis. This structure plunges to the southwest in Iowa which accounts for the slight southwestern regional dip in the southeastern part of the state. Superimposed upon this regional dip are numerous anticlines with axes trending northwest-southeast, parallel to the regional strike. Due to the difference in thickness of the Osage age sediments over the synclines and anticlines, these features are thought to have an age of deformation of before or around Early Mississippian. There are no faults recognized in or near Wapello County.

2.0126 Seismology. Iowa has a history of slight earthquake activity, with only two shocks of Intensity V or greater on the Modified Mercalli Scale epicentrally located within the state. However, 23 earthquakes with epicenters outside of Iowa have been felt in some portion of the state. There have been no earthquakes reported within 50 miles of the site.

2.01261 Iowa is located in Zone 1 of the U.S. Coast and Geodetic Survey's Seismic Risk Map for the United States. This designation indicates the possibility of an earthquake with an Intensity V or VI (MM) occurring in this area, or minor damage caused from a major distant disturbance.

2.013 Site Geology

2.0131 Topography. The Ottumwa Generating Station site is located southwest of the flood plain of the Des Moines River on a terrace cut into Kansan age till, northwest of Chillicothe in Wapello County, Iowa. Middle Avery Creek passes through the site flowing from the southwest to the northeast into the Des Moines River. The surrounding area is included in the hilliest part of Iowa with gently curving hillsides sloping to the terrace level of the valley. Maximum relief in the site area is approximately 100 feet, with the terrace level ranging from 25 to 35 feet above the flood plain which lies at an elevation of about 650 feet MSL.

2.0132 Soil and bedrock conditions. The following descriptions were obtained from the logs of the drilling program initiated to supply information concerning the general surface and subsurface conditions present at the site. Surficial deposits in the site area range in thickness from 41.5 feet on the high ground in the western part of the site, to 12.5 feet on the low ground along the flood plain of the Des Moines River. In the western part of the site and in the proposed main plant area on the terrace, the surficial deposits consist of brown and/or gray medium stiff to very stiff clayey soils overlying several feet of sand. The shallow soils are believed to be glacial tills while the deeper clays and sands are residual soils weathered from parent shales and sandstones. On the low ground along the Des Moines River flood plain the surficial deposits are composed of very soft to medium stiff clayey soil with some organic material, underlain by sands containing fine material. In these areas the shallow soils are relatively recent alluvial deposits and the deeper, cleaner sands are residual soils. The surficial material in the site area south of Avery Creek is again dark brown, soft to medium stiff clay or silty clay underlain by sand. The shallow soils just south of the creek are recent alluvium, the rest are glacial tills, with the deeper sands considered residual soils.

2.01321 The Pennsylvanian age bedrock was intercepted during the drilling program in the upland area in the northwestern part of the site. The Pennsylvanian rocks are primarily dark gray and black shales with occasional pyrite veins and thin coal seams plus gray siltstone and sandstone. The slope of the Pennsylvanian strata was observed to be up to 15 degrees in individual core samples.

2.01322 The Mississippian age rocks lie below the Pennsylvanian at depths from 40 to more than 80 feet below the surface in the northwestern upland area of the site. In the eastern and southern portions of the site these same rocks are present immediately below the soil cover, with dip to the north ranging from 0.1 to 0.4 degrees. Through much of the area the Mississippian rock sequence displays three prominant divisions: a 10 to 15 foot thick limestone believed to be the St. Genevieve Formation; an intermediate 10 to 20 foot thick sandstone unit underlain by a 20 foot or more thick limestone bed, the St. Louis Formation; and below this a sequence of dolomite and limestone thought to be the Spergen Formation.

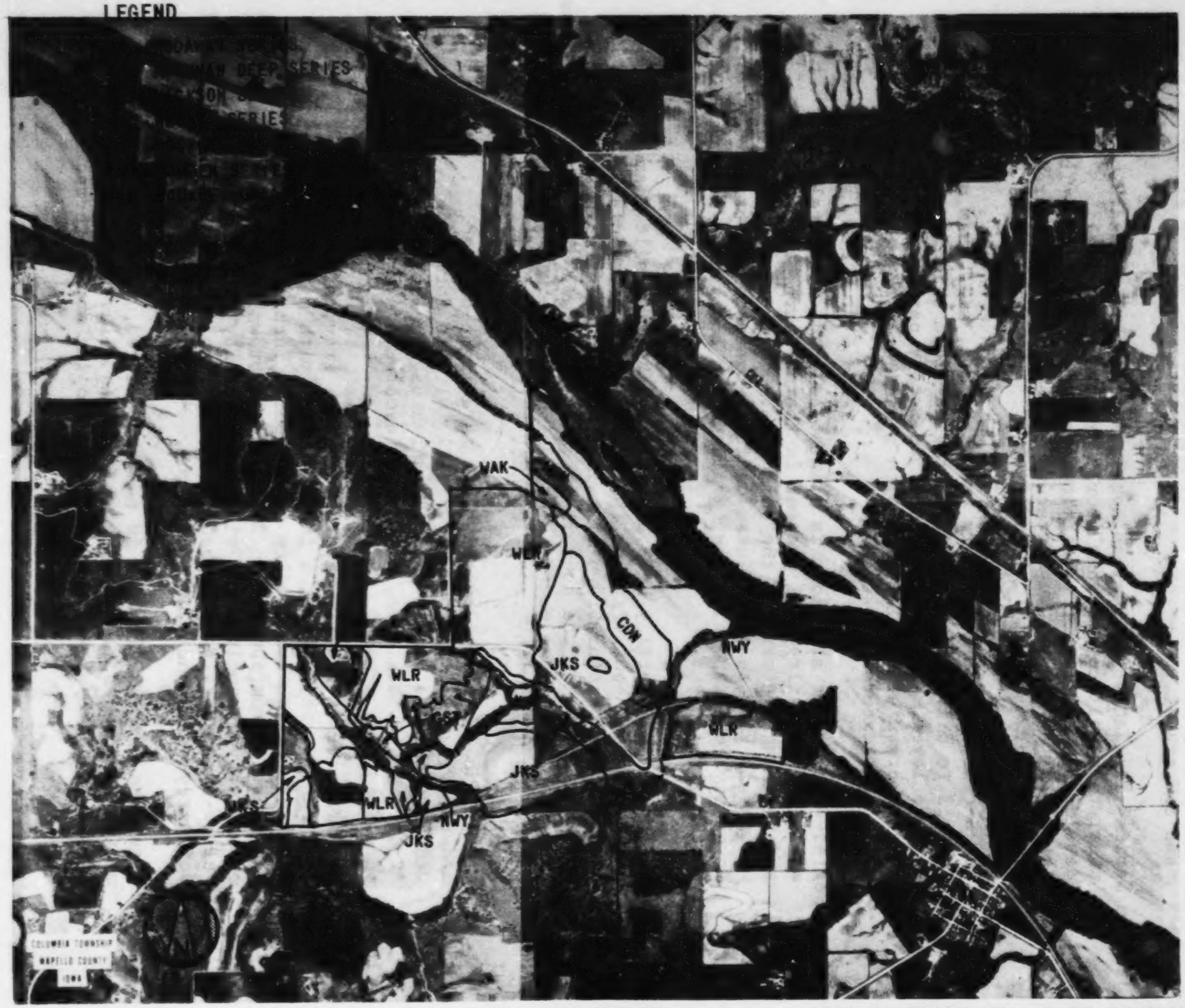
2.0133 Soil series. A map showing the soil series distribution in the site area is presented on Figure 2-3. The following descriptions were taken from the interpretations developed by Jeffrey G. Anliker, District Conservationist in cooperation with Wapello County Soil Conservation District.

Nodaway Series--The Nodaway silt loam occurs on the flood plain of the Des Moines River and Middle Avery Creek. It consists of moderately well-drained, silty, bottomland soils that have developed in recently deposited, stratified, silty alluvium on first bottomlands. These soils are nearly level with a typical 0 to 2 per cent slope, but some areas may be slightly undulating due to remnants of the old meandering stream channel.

Nodaway soils usually have a dark grayish-brown silt loam surface layer about 7 inches thick, beneath which is a stratified, grayish-brown and dark grayish-brown silt loam containing a very few thin strata of silty clay loam that extends to a depth of more than 60 inches.

Marshan, Deep Series--The Marshan clay loam, deep, occurs on the terrace of the Des Moines River. This soil type has sand and gravel at 32 to 40 inches and are leached of carbonates. It is dark colored, poorly-drained loamy soils developed in glacial outwash and alluvium under prairie vegetation. It occurs on stream terraces and nearly level upland outwash areas.

The Marshan soils have a black, gritty, silty clay loam surface layer 22 inches thick with a dark-gray, moderately permeable



PLANT SITE INVESTIGATION
IOWA SOUTHERN UTILITIES COMPANY
CENTERVILLE, IOWA
1974

IOWA SOUTHERN UTILITIES COMPANY
OTTUMWA GENERATING STATION
SOIL SERIES DISTRIBUTION AT THE SITE

FIGURE 2-3

loam to clay loam subsoil. The substratum is mottled grayish-sand and gravel.

Jackson Series--The Jackson silt loam consists of light-colored, moderately well to somewhat poorly drained silty soil developed under forest vegetation from silty alluvium. It is present on low stream terraces generally above the present flood plain.

The Jackson soils have a dark grayish-brown, silt loam surface layer 3 to 6 inches thick and a grayish-brown silt loam subsurface layer. The subsoil is a moderately permeable, mottled grayish-brown silty clay loam with a similarly colored but silt loam textured substratum.

Weller Series--The Weller silt loam is a light colored, moderately well-drained, silty soil present in the northern, western, and southeastern part of the site area. It is formed in moderately fine textured loess under a vegetation of trees on gently to moderately sloping sideslopes and gently sloping convex ridges.

Weller soils generally have a dark grayish-brown silt loam surface layer about 7 inches thick with a subsurface layer of about 5 inches of brown silt loam with platy structure. Below 12 inches of the subsoil is yellowish-brown silty clay loam containing some mottles in the lower part. The lower subsoil is yellowish-brown, leached, silty clay loam.

Gosport Series--The Gosport silty clay loam is a light-colored, moderately well-drained, clayey soil. It has formed in weathered Pennsylvanian shales under a vegetation of trees. It occurs on sideslopes, and upland escarpments which often parallel major streams.

Gosport soils typically have a very dark gray, silty clay loam surface layer about 4 inches thick, with a subsurface layer of grayish-brown silty clay about 3 inches thick. The subsoil from about 7 to 27 inches is brown to grayish-brown, very strongly acid, silty clay or clay with distinct yellow-brown mottles and shale fragment with an extremely acid gray shale and clay substratum.

Camden Series--The Camden silt loam is a light-colored, well drained, medium textured soil present developed in alluvium under forest on nearly level to moderately sloping stream terraces.

The Camden soils have a dark grayish-brown silt loam surface 2 to 4 inches thick underlain by a subsurface layer of grayish-brown silt loam. The subsoil is a moderately permeable, dark-yellowish-brown, silt clay loam increasing in sand with depth. The lower subsoil is a yellowish-brown sandy loam at 36 to 45 inches with a loamy sand substratum.

Waukee, Uplands Series—The Waukee loam of the uplands is a dark-colored, well-drained, medium textured soil with sands at about 3 feet, developed from water laid outwash material in the uplands beneath prairie vegetation.

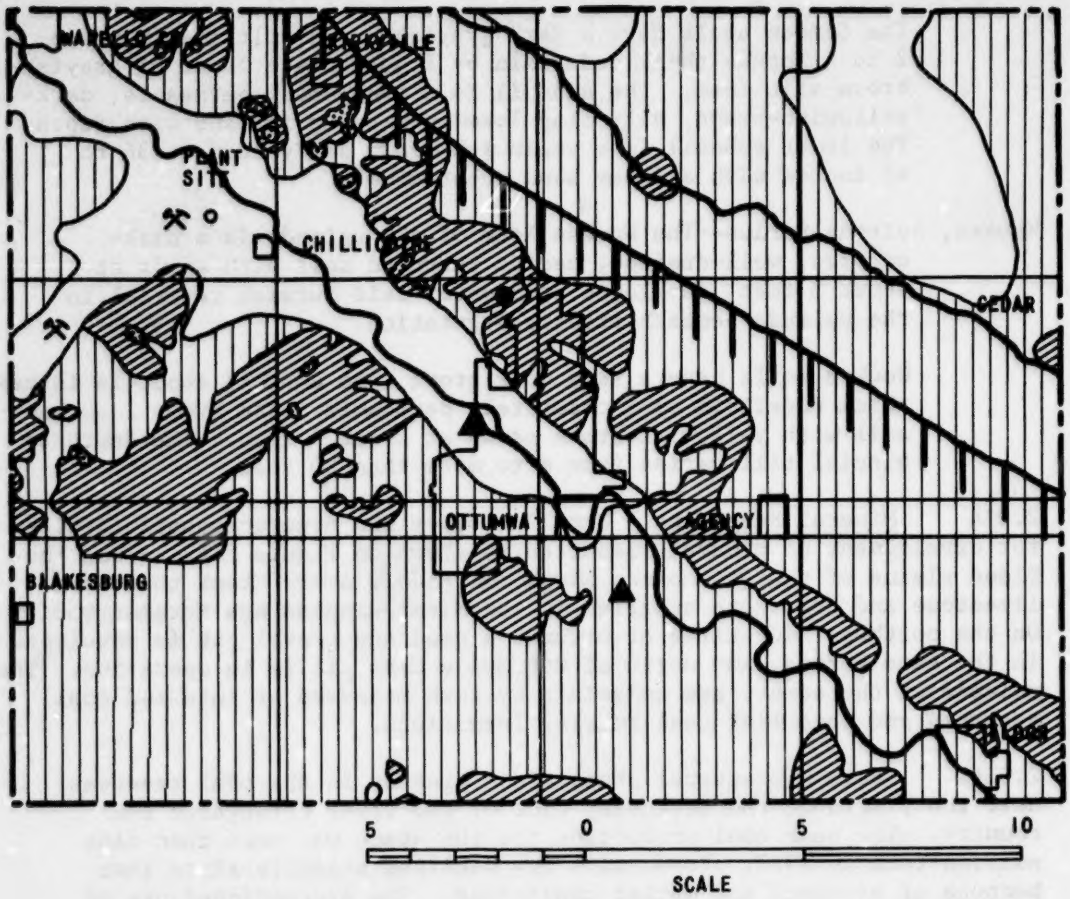
Waukee soils have a very dark brown loam surface about 14 inches thick underlain by a moderately permeable, dark brown loam subsoil with yellowish-brown sands at about 3 feet. The depth to glacial till varies from 8 to more than 20 feet.

2.014 Mineral Resources. Wapello County has numerous possibilities for development of mineral resources as shown on Figure 2-4. Along the flood plains of the Des Moines River and Middle Avery Creek there are limestone and dolostone quarries in the Mississippian age Meramec Series. On the northwest outskirts of Ottumwa a sand and gravel pit is developed in the same series, and north of Ottumwa a clay pit is in operation. The uplands of the county are underlain by both measured or inferred coal reserves and potential coal bearing formations.

2.0141 There are several strip mines present in the coal reserves near the bluffs on the northeast side of the river throughout the country. The peak coal production for the state was more than nine million tons in 1917. Production has declined steadily since then because of economic and market conditions. The discontinued use of coal by the railroads and many domestic users were major factors in reduced market demand.

2.0142 Three-fourths of the county is underlain by the northeastern edge of a zone of potential gypsum and anhydrite deposits of Mississippian age, and the entire county overlies similar deposits in Devonian age formations.

FIGURE 2-4



- ⚒ QUARRIES
- ▲ SAND AND GRAVEL PITS
- ● CLAY PITS
- ▒ COAL STRIP MINES
- ▨ AREAS UNDERLAIN BY MEASURED OR INFERRED COAL RESERVES.
- ▥ AREAS UNDERLAIN BY POTENTIALLY COAL BEARING ROCK FORMATIONS.
- ⫪ AREAS UNDERLAIN BY POTENTIAL GYPSUM AND ANHYDRITE DEPOSITS IN MISSISSIPPI AGE FORMATIONS.

SOURCE: IOWA GEOLOGICAL SURVEY MISCELLANEOUS MAP SERIES 4, 1973.

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

MINERAL RESOURCES OF WAPELLO COUNTY

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2.02 Hydrology

2.021 Introduction. This section is a summary of the surface water and ground water hydrology for Iowa Southern Utilities Company Ottumwa Generating Station Site, based on available literature and records. No records are available for the site itself. The surface water and ground water include information on the present resources, quality, and use of the water in the vicinity of the site.

2.022 Surface Water. The Ottumwa Generating Station site is located on a terrace adjacent to the flood plain of the Des Moines River in Wapello County, Iowa between River Miles 104 and 107. Middle Avery Creek passes through the site flowing from the southwest to the northeast into the Des Moines River between River Miles 105 and 106.

2.0221 The Des Moines River will be the primary source of water for the Ottumwa Generating Station.

2.0222 The Des Moines River originates in Murray County in Southern Minnesota and enters the Mississippi River just south of U.S. Lock & Dam No. 19. The drainage basin of the river is long and narrow having a fairly regular outline and lateral boundry with a total area at the mouth of 14,467 square miles. Figure 2-5 shows a location plan for the site and for the drainage basin of the Des Moines River. At the site the Des Moines River has 13,323 square miles of controlled drainage area and approximately 870 square miles of uncontrolled. Control has been maintained since 1969 by the Corp of Engineers with Red Rock Dam and Reservoir. Saylorville Dam and Reservoir which is presently under construction will aid Red Rock in controlling flow in the river upon its completion.

2.0223 The operational plan for Red Rock Dam and Reservoir has been set up to limit releases to a discharge of 30,000 cfs at Ottumwa during the nongrowing season (December 16 to April 20) and 18,000 cfs during the growing season (April 21 to December 15). Release during drought periods will augment a minimum discharge of 300 cfs at Ottumwa.

2.0224 Table 2-1 summarizes the mean and minimum flows on a monthly and yearly basis since Red Rock Dam and Reservoir has been in operation. The maximum discharge, during this period was 33,600 cfs on May 2, 1973, and the minimum daily discharge was 54 cfs on September 16, 1971.

2.0225 Figure 2-6 shows an anticipated discharge-frequency curve of the Des Moines River at Ottumwa as modified by Red Rock and Saylorville Dams and Reservoirs.

TABLE 2-I

MONTHLY AND YEARLY MEAN DISCHARGE IN CUBIC FEET PER SECOND OF DES MOINES RIVER AT OTTUMWA

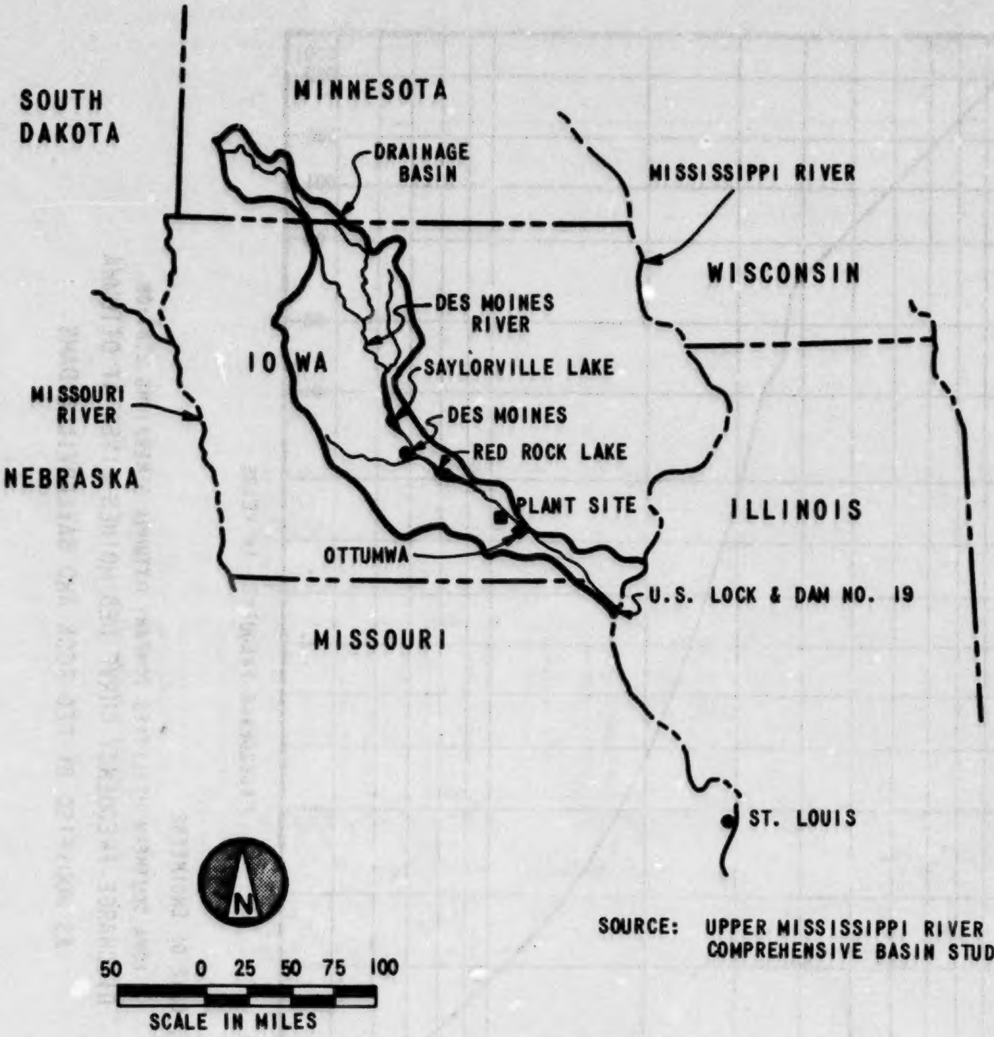
WATER YEAR	1969	1970	1971	1972	1973
OCT	5,078	1,962	4,387	367	5,789
NOV	4,699	2,137	3,383	1,659	13,810
DEC	1,851	1,231	2,872	1,562	5,519
JAN	1,743	1,008	1,216	825	12,380
FEB	1,969	1,580	9,387	913	16,470
MAR	7,807	6,132	18,600	4,709	16,770
APR	20,660	7,664	9,711	3,094	24,570
MAY	14,640	9,999	5,462	10,750	24,800
JUNE	17,520	4,667	6,594	8,760	19,180
JULY	16,730	1,363	4,353	6,014	19,600
AUG	17,110	2,687	953	9,700	17,380
SEPT	6,214	2,824	439	7,737	7,012
WATER YEAR	9,703	3,613	5,589	4,688	15,250
CALENDER YEAR	2,035	9,175	4,061	4,995	6,477

SOURCE: WATER RESOURCES DATA FOR IOWA 1974

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

MEAN MONTHLY AND ANNUAL FLOWS
DES MOINES RIVER AT OTTUMWA
SINCE RED ROCK DAM AND
RESERVOIR HAS BEEN IN OPERATION

FIGURE 2-5

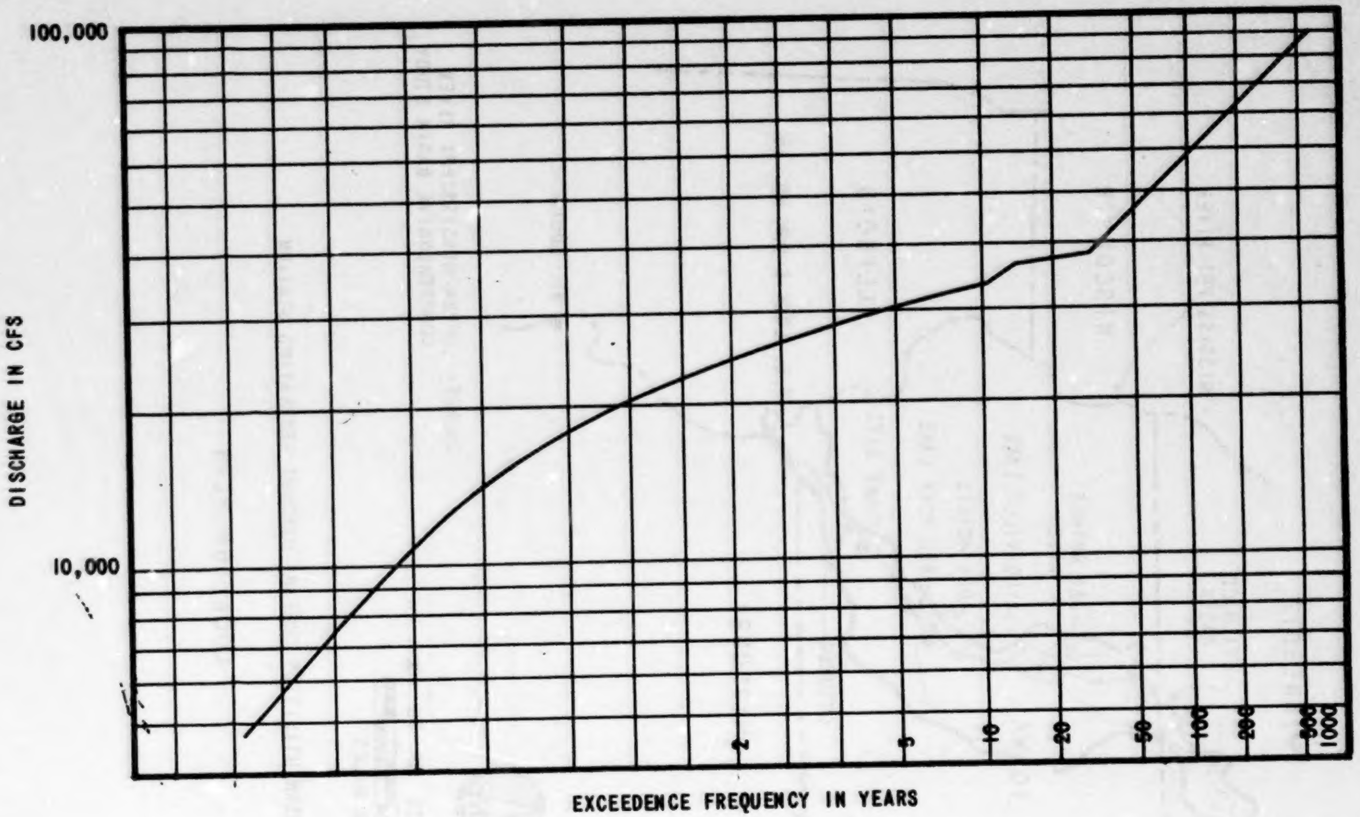


SOURCE: UPPER MISSISSIPPI RIVER COMPREHENSIVE BASIN STUDY

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

LOCATION PLAN

FIGURE 2-6



SOURCE: U.S. ARMY, CORP OF ENGINEERS

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

DISCHARGE-FREQUENCY CURVE DES MOINES RIVER AT OTTUMWA
AS MODIFIED BY RED ROCK AND SAYLORVILLE DAMS

2.0226 Saylorville Reservoir is not yet operational. Construction on the dam embankment was completed in October 1975; however, additional construction remains before the project will be finished and available for complete utilization. Construction activities presently are underway at the proposed recreation areas.

2.0227 Preliminary plans have been developed for operating Saylorville Reservoir. Conservation objectives will be to augment Des Moines River flows during low-flow periods while maintaining a steady pool for recreation at 833 feet MSL, during normal periods. Minimum flows will be maintained of 200 cfs at Des Moines and 300 cfs at Ottumwa.

2.0228 Since a minimum flow of 300 cfs presently is maintained at Ottumwa, the completion and operation of Saylorville Reservoir will not affect planning for the Ottumwa Generating Station.

2.0229 Extreme flows have occurred on the Des Moines River. Mean discharges during the 1947 water year was the highest on record (9,660 cfs at Tracy) while the mean discharge during the 1956 water year was the lowest on record (496 cfs at Tracy). Figure 2-7 shows hydrographs for the 1947 and 1956 water years at Tracy and how they might have been altered by the operation of Red Rock Dam.

2.02210 Figures 2-8, 2-9, and 2-10 show the daily-discharge duration curve, minimum average flow curve and magnitude-frequency curve for the Des Moines River period at Ottumwa. The 90 per cent maximum flow value of daily discharge was 397 cfs and the 10-year, 7-day low flow was 100 cfs.

2.02211 The quality of the Des Moines River water at the site can be approximated from the chemical analysis and temperature measurements taken at Ottumwa. Concentrations of dissolved solids are highest during periods of low discharge and lowest during high discharges.

2.02212 Table 2-2 shows chemical analysis of the Des Moines River water at Ottumwa (1956-1968). Other water quality data are given in section 2.06. Table 2-3 summarizes the mean and minimum monthly water temperatures of the Des Moines River at Ottumwa (1969-75) since Red Rock Dam and Reservoir has been in operation.

2.023 Ground Water. The Ottumwa Generating Station is underlain by three sedimentary bedrock aquifers and is adjacent to the alluvial aquifer underlying the flood plain of the Des Moines River.

2.0231 Figure 2-11 shows the hydrological bedrock units map for Wapello County and Figure 2-12 shows a generalized hydrological bedrock units cross-section cut perpendicular to the Des Moines River below the site.

Dissolved constituents and hardness in milligrams per liter. Analysis by State Hygienic Laboratory of Iowa

Date Collected	Discharge (cfs)	Temperature F	Temperature C	Silica (SiO2)	Iron (Fe) Soluble	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO3)	Carbonate (CO3)	Sulfate (SO4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO3)	Dissolved Solids	Hardness as CaCO3	Phosphate (PO4) Total	Organic Nitrogen	Chemical Oxygen Demand (C.O.D.)	Specific Conductance (Micromhos at 25 C)	pH
6-18-56	609	84	29	9.8	0.08	*	61	20	21	5.4	190	2.4	105	20	0.4	8.0	391	234	1.9	1.6	28	544	8.0
10-08-56	170	63	17	1.2	.20	0.84	52	29	33	6.2	178	0	128	30	.3	.89	393	250	1.1	.93	36		8.0
2-04-57	222	37	2.8	6.0	.30	1.0	99	38	67	7.7	348	0	149	73	.2	3.5	671	402	4.2	1.8	50	1110	8.3
5-27-57	2,860	70	21	6.8	.12	*	50	25	18	4.6	176	0	86	18	.4	13	351	230	.90	2.1	38	529	8.0
9-09-57	650	70	21	.8	.10	*	57	25	25	5.2	178	4.8	111	21	.35	.44	373	246	.96	1.1	25	578	8.3
10-21-57	321	59	15	4.0	.14	.17	67	22	28	6.2	215	2.4	109	27	.25	2.7	387	260	1.0	1.4	26	625	8.2
1-06-58	1,000	30	-1.1	10	.06	*	114	38	27	3.9	359	6.0	146	23	.50	20	601	444	.92	1.0	35	865	8.4
4-21-58	2,120	64	18	.9	.14	.05	66	32	16	3.1	193	9.6	117	14	.40	16	420	296	.83	1.2	24	594	8.4
6-30-58	2,070	79	26	13	.32	*	55	30	15	2.8	161	4.8	106	14	.40	8.9	360	260	.80	1.6	25	546	8.1
3-02-59	6,560	35	1.7	6.8	1.1	*	37	11	5	12	129	0	37	6	.20	4.4	277	148	3.7	3.8	160	320	7.7
6-01-59	37,200	66	19	14	2.0	*	40	13	4.2	4.2	137	0	43	4	.30	12	270	154	3.9	2.4	74	306	7.9
8-24-59	898	88	31	5.2	.02	*	76	16	16	4.4	215	6.0	82	7.5	.40	.44	385	256	.96	.63	29	505	8.3
11-23-59	1,930	33	.6	3.2	.08	*	64	29	18	4.5	193	7.2	111	20	.40	2.2	393	280	.86	.73	29	595	8.5
2-15-60	3,350	32	0	12	.06	.22	84	28	14	3.4	242	0	104	14	.35	13	437	324	.69	.55	8	639	7.8
4-11-60	20,900	44	6.7	16	.10	*	66	19	5.6	3.6	200	0	66	6	.35	19	362	242	1.8	1.8	49	490	8.0
6-27-60	7,000	73	23	22	.06	*	86	24	8.8	2.9	251	7.2	75	8	.55	24	341	312			44	612	8.2
9-26-60	10,000	64	18	10	.14	*	27	11	5.2	5.0	100	0	31	7	.25	7.1	241	112	4.7	2.2	72	253	8.1
1-03-61	700	32	0	10	.10	.34	126	39	30	3.8	388	1.2	169	28	.35	5.8	631	476	13	1.2	26	937	8.1
5-29-61	5,310	66	19	11	.04	*	93	32	11	2.8	259	14	108	9	.55	19	462	364	1.0	1.0	33	664	8.4
11-27-61	6,400	42	5.6	19	.06	*	88	26	11	2.6	273	4.8	85	9	.35	13	438	328	1.3	1.0	17	635	8.1
1-29-62	2,700	32	0	18	.12	.29	97	30	17	2.8	322	0	119	16	.35	11	487	366		.47		729	7.6
6-03-63	4,680	73	23	14	.06	*	91	28	13	2.6	284	4.8	76	11	.35	18	464	344	.80	.85	26	656	8.1
2-03-64	490	32	0	8.2	.08	.45	94	31	39	4.8	273	17	124	38	.35	5.3	527	364	2.3	2.3	48	527	8.4
8-31-64	1,450	77	25	4.8	.12	.12	64	22	19	5.8	205	0	99	19	.35	.9	359	252	1.0	1.1	39	567	7.8
6-07-65	22,600	68	20	16	1.3	.14	61	14	5.6	2.8	178	0	65	6	.35	17	468	208	4.6	6.4	175	427	8.0
3-28-66	5,880	45	7	16	.16	*	85	20	12	3.8	242	0	86	14	.30	7.1	397	296	1.4	1.9	54	621	8.0
4-03-67	2,440	57	14	9.5	.36	.40	53	16	18	7.0	150	0	83	14	.40	3.9	322	196	1.0	1.3	35	470	7.6
7-10-67	5,780			21	.10	*	104	25	12	3.2	300	0	96	16	.45	23	482	364	1.0	.47	28	740	8.2
1-08-68	155	36	2	4.0	.26	1.2	103	36	50	5.8	332	0	170	45	.3	1.9	613	404				910	8.2
5-06-68	1,630										140	0		29		5.0	352		1.0	2.3	9.9	540	8.2
RANGE		High		22	2.0	1.2	126	39	67	12	388	17	170	73	0.55	24	671	476	13	6.4	175	1100	8.5
		Low		.8	.02	*	27	11	4.2	2.6	100	0	31	4	.2	.44	241	112	.80	.47	8	253	7.6

* Less than 0.05.

Source: Water Resources of Southeast Iowa

Iowa Southern Utilities Company - Ottumwa Generating Station
CHEMICAL ANALYSES OF DES MOINES RIVER WATER AT OTTUMWA

Table 2-2

TABLE 2-3

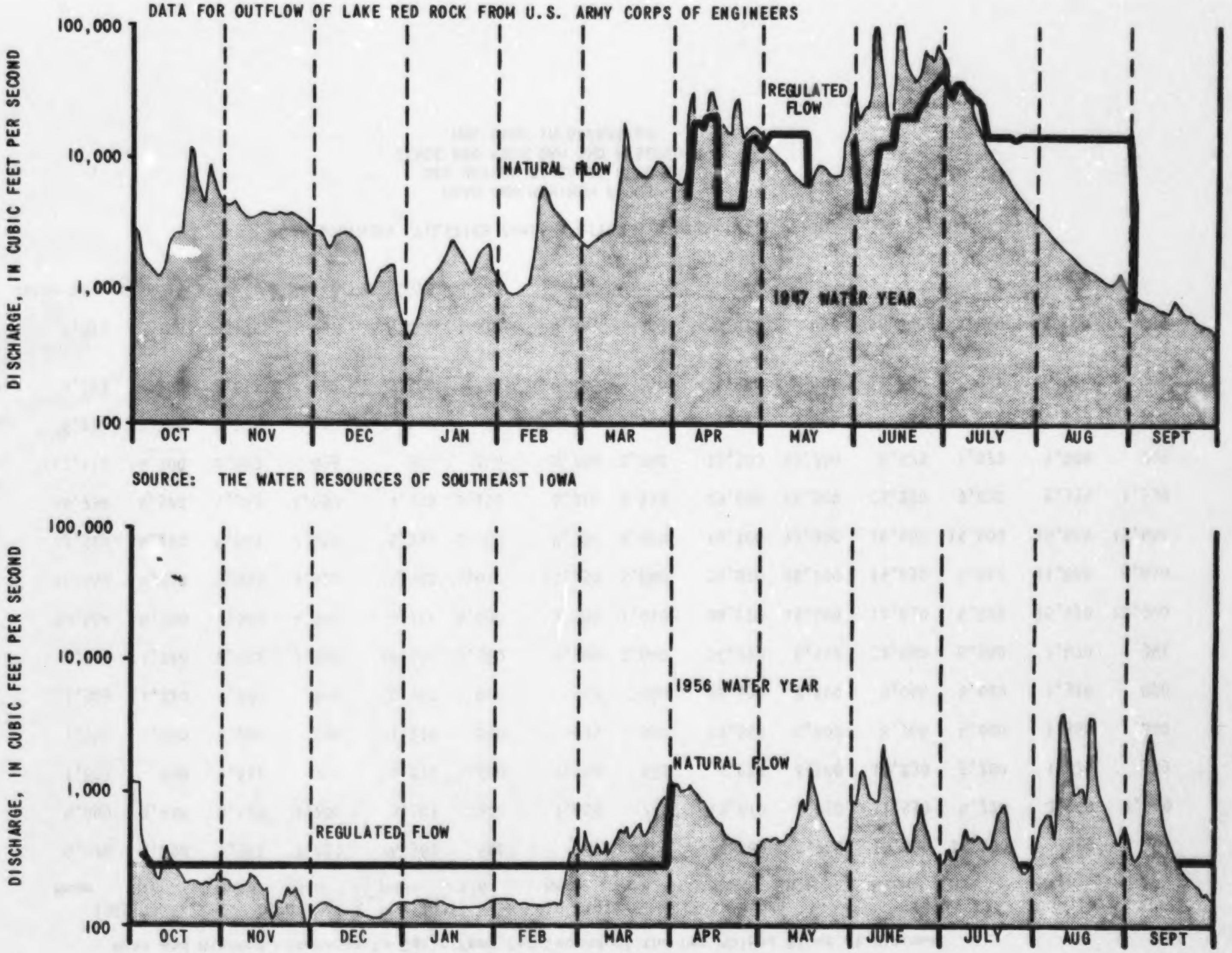
Mean and Minimum Discharge in Cubic Feet Per Second of the Des Moines River at Ottumwa

Water Year	1969		1970		1971		1972		1973		1974		1975	
	Mean	Min	Mean	Min	Mean	Min	Mean	Min	Mean	Min	Mean	Min	Mean	Min
Oct	5,078	1,250	1,962	1,020	4,387	656	367	240	5,789	2,700	18,390	15,200	599	485
Nov	4,699	3,430	2,137	1,200	3,383	1,280	1,659	715	13,810	7,830	11,530	4,720	2,069	1,050
Dec	1,851	900	1,231	751	2,872	1,500	1,562	385	5,519	2,900	10,830	5,200	1,874	539
Jan	1,743	1,000	1,008	500	1,216	600	825	520	12,380	5,600	8,768	4,000	1,368	600
Feb	1,969	1,220	1,580	800	9,387	900	913	450	16,470	7,200	9,054	4,600	1,316	870
Mar	7,807	1,720	6,132	1,330	18,600	9,360	4,709	2,640	16,770	6,510	12,850	6.990	7,470	941
Apr	20,660	4,790	7,664	4,980	9,711	4,490	3,094	1,630	24,570	15,400	12,650	6,870	16,430	12,900
May	14,640	4,890	9,999	3,420	5,462	3,410	10,750	5,840	24,800	18,100	15,230	8,010	11,860	5,630
June	17,520	16,200	4,667	2,450	6,594	2,750	8,760	4,070	19,180	17,900	18,590	15,400	16,640	13,600
July	16,730	6,520	1,363	1,050	4,353	2,150	6,014	2,310	19,600	18,300	15,590	9,030	9,334	1,530
Aug	17,110	16,100	2,687	499	953	346	9,700	2,740	17,380	13,700	4,873	1,570	1,808	709
Sept	6,214	1,740	2,824	322	439	54	7,737	1,340	7,012	3,460	1,035	571	1,939	740
Water Year	9,703	900	3,613	322	5,589	54	4,688	240	15,250	2,700	11,640	571	6,064	485
Calender Year	2,035	100	9,175	751	4,061	322	4,995	54	6,477	450	16,640	3,460	8,594	485

Source: Water Resources Data for the Years 1967-1975

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

MEAN AND MINIMUM FLOWS
DES MOINES RIVER AT OTTUMWA
SINCE RED ROCK DAM AND RESERVOIR
HAS BEEN IN OPERATION



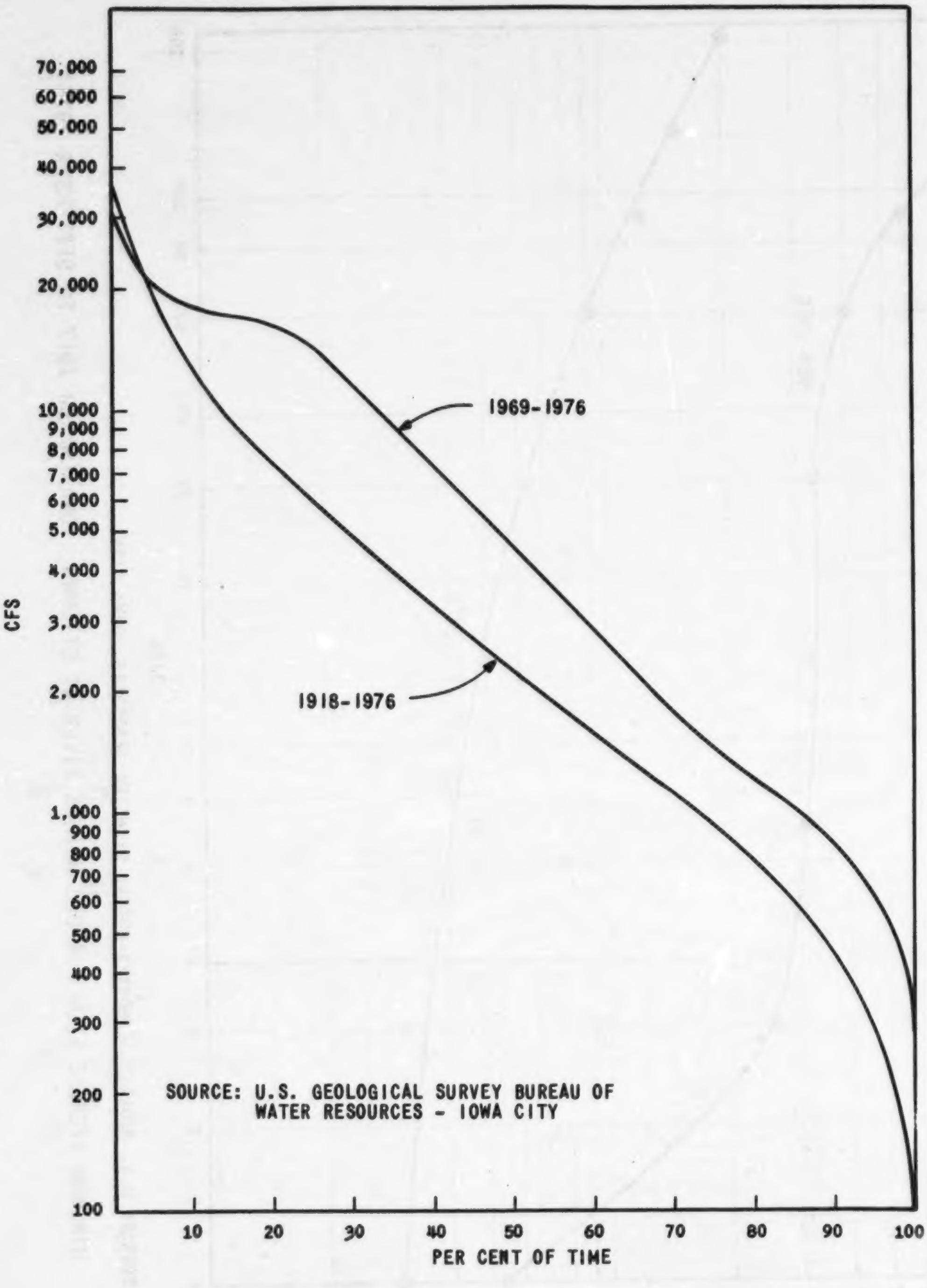
DATA FOR OUTFLOW OF LAKE RED ROCK FROM U.S. ARMY CORPS OF ENGINEERS

SOURCE: THE WATER RESOURCES OF SOUTHEAST IOWA

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

HYDROGRAPHS FOR 1947 AND 1956 WATER YEARS AT TRACY
ALTERED BY THE OPERATION OF RED ROCK DAM

FIGURE 2-8

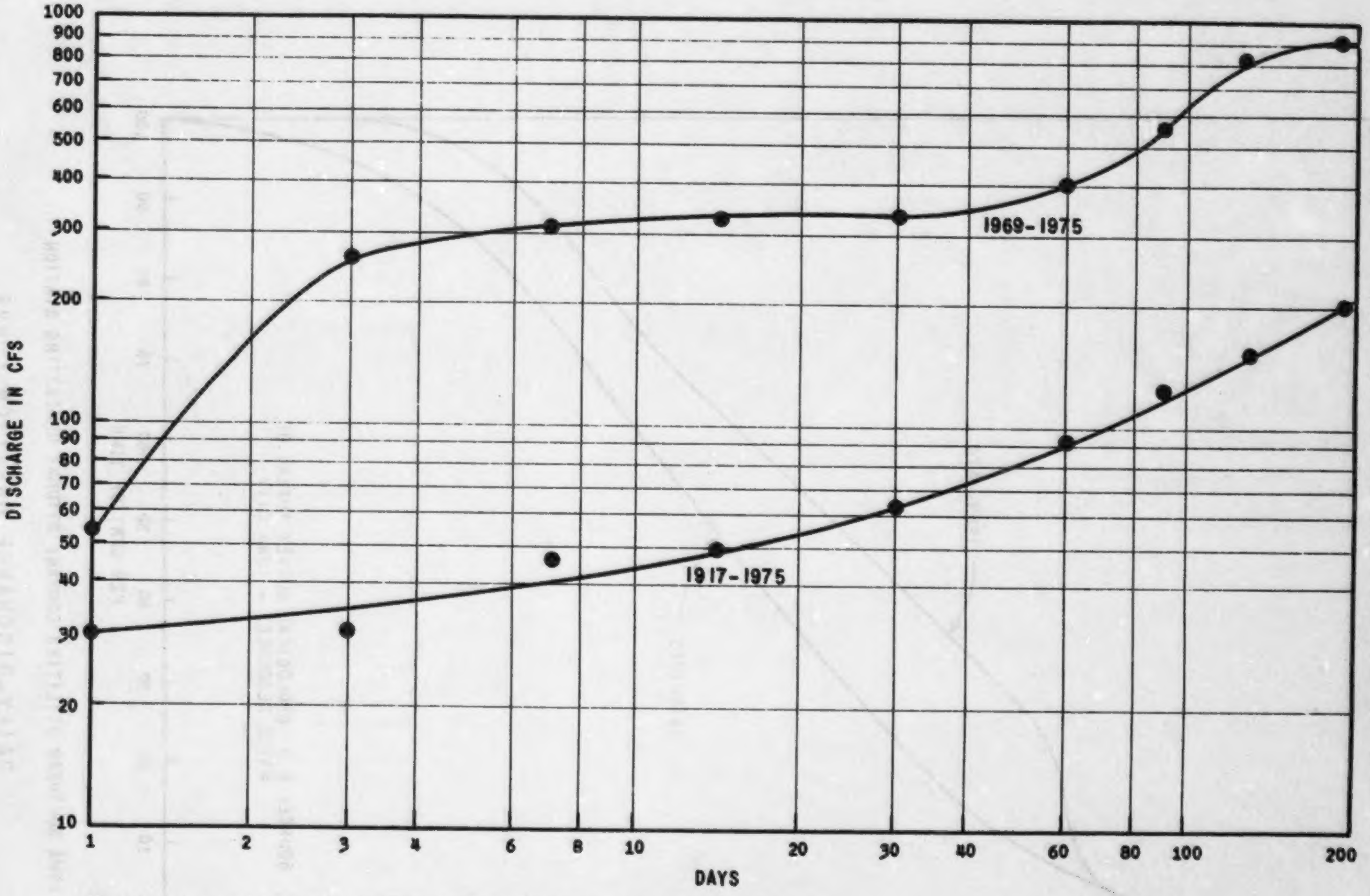


SOURCE: U.S. GEOLOGICAL SURVEY BUREAU OF WATER RESOURCES - IOWA CITY

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

DAILY-DISCHARGE DURATION CURVE
(1918-1976)

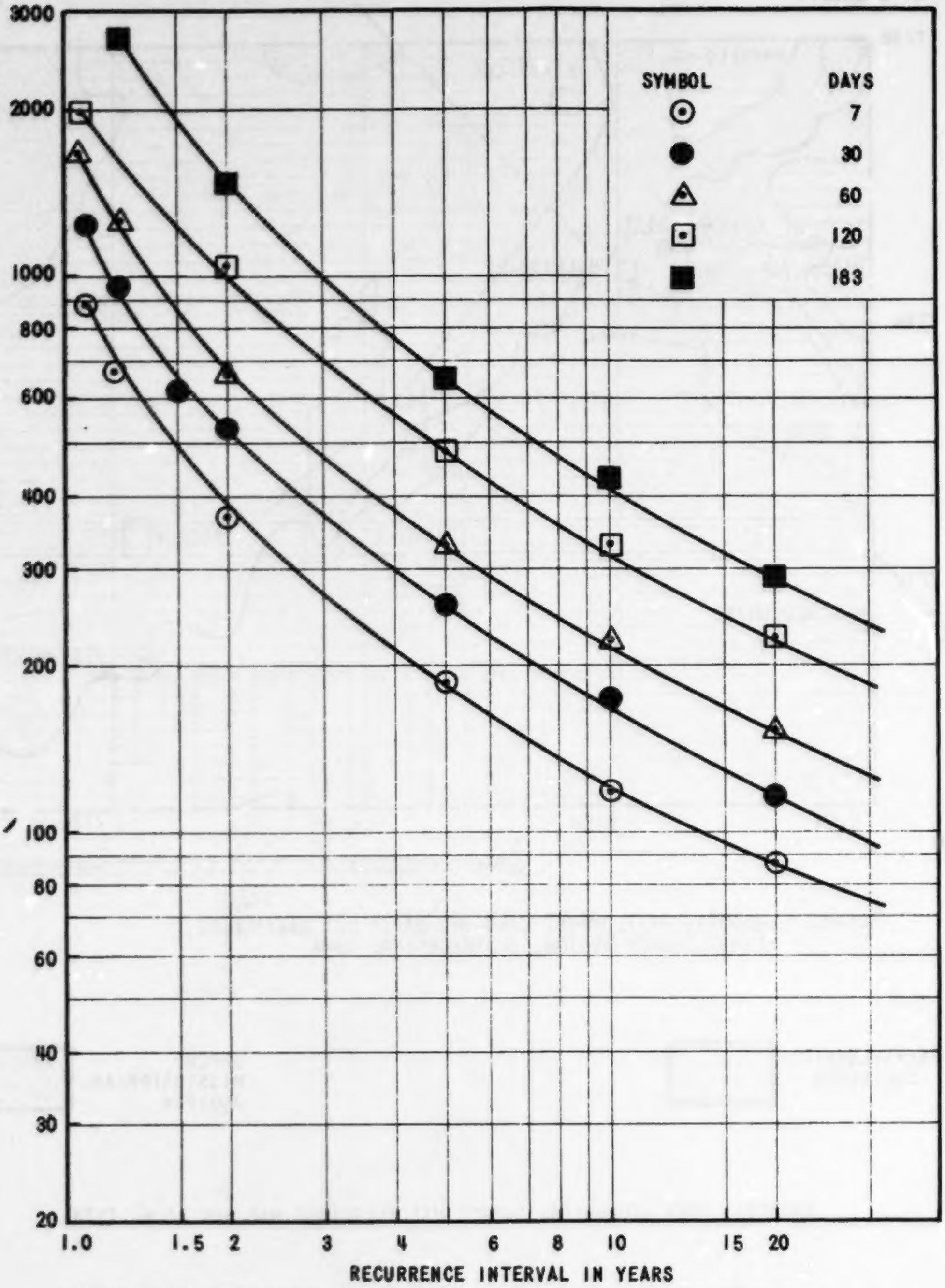
FIGURE 2-9



SOURCE: U.S. GEOLOGICAL SURVEY-BUREAU OF WATER RESOURCES, IOWA CITY.

MINIMUM AVERAGE FLOW FOR DES MOINES RIVER AT OTTUMWA, IOWA (MARCH 1917 TO SEPTEMBER 1975)

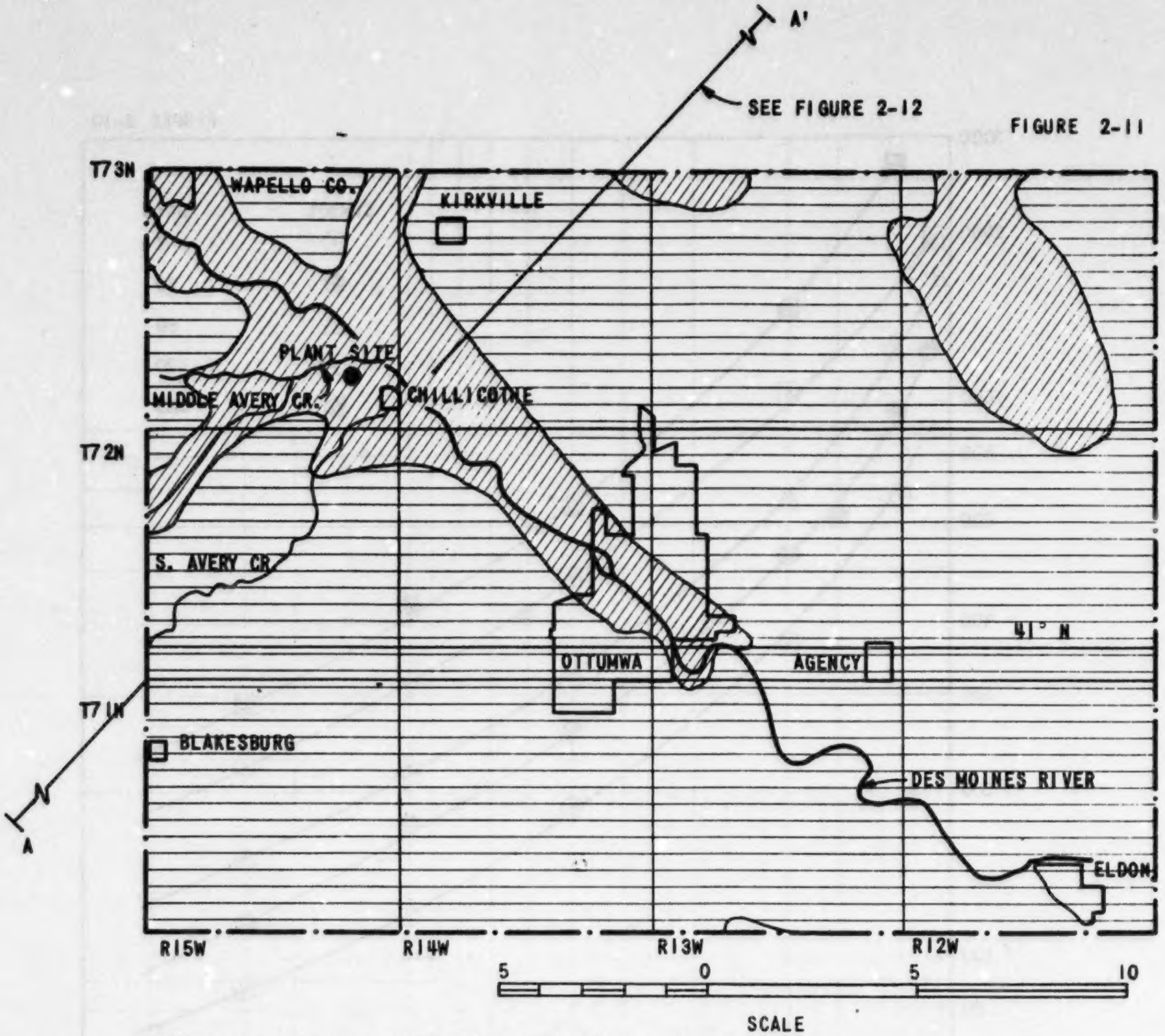
FIGURE 2-10



SOURCE: U.S. GEOLOGICAL SURVEY-WATER RESOURCES DIVISION, IOWA CITY.
IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

MAGNITUDE AND FRQUENCY OF ANNUAL LOW FLOWS
FOR DES MOINES RIVER AT OTTUMWA, IOWA (1917-1971)

FIGURE 2-11



SOURCE: RESOURCE DEVELOPMENT LAND-AND-WATER USE MANAGEMENT, ELEVEN COUNTY REGION, SOUTH-CENTRAL IOWA

PENNSYLVANIAN-AQUICLUDE ▤

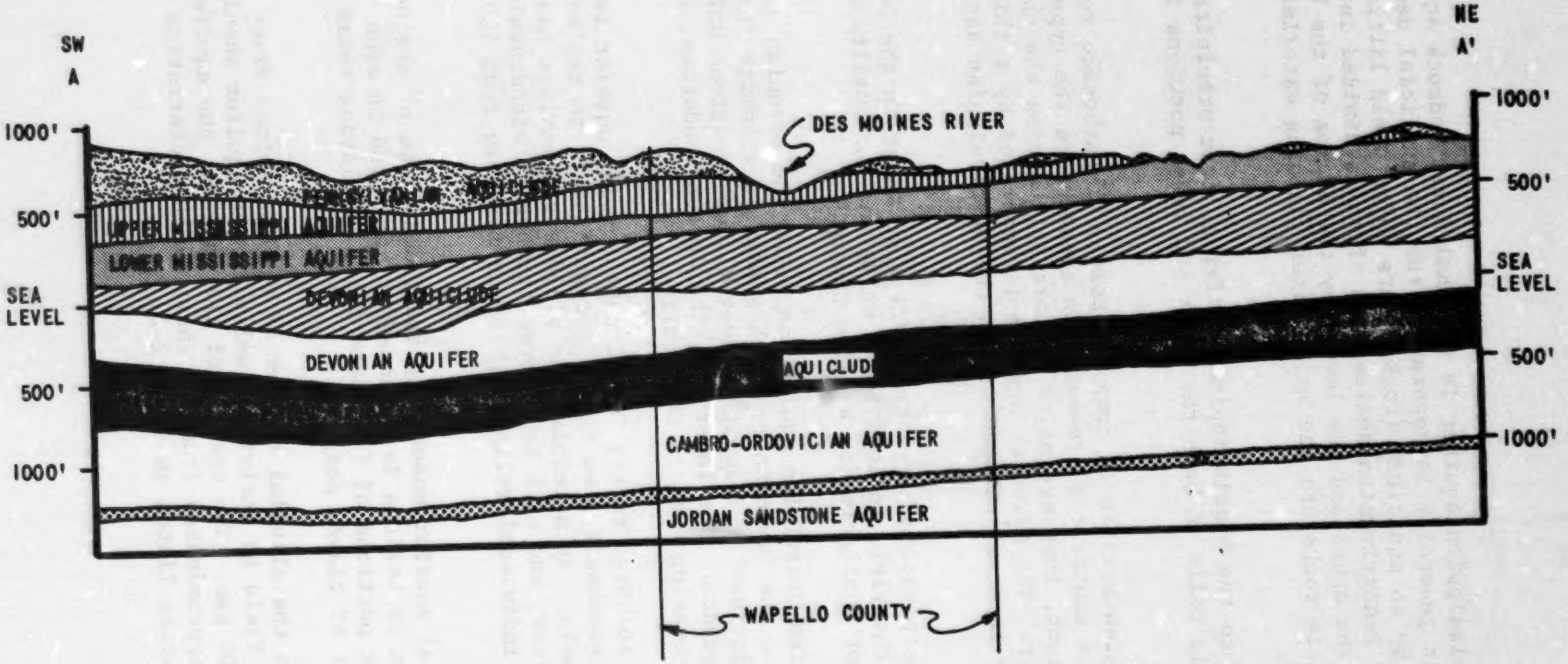
UPPER MISSISSIPPIAN-AQUIFER ▨

SOURCE: IOWA GEOLOGICAL SURVEY MISCELLANEOUS MAP SERIES 4, 1973.

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

HYDROLOGICAL BEDROCK UNITS MAP-WAPELLO COUNTY

FIGURE 2-12



SOURCE: RESOURCE DEVELOPMENT LAND-AND-WATER USE MANGEMENT, ELEVEN COUNTY REGION, SOUTH-CENTRAL IOWA

IOWA SOUTHERN UTILITIES COMPANY OTTUMWA GENERATING STATION

HYDROLOGICAL BEDROCK UNITS MAP

2.0232 The Mississippian aquifer is the shallowest bedrock aquifer in Wapello County. It generally is separated from the surficial deposits within the county by an aquiclude (rock layers which yield little or no water to wells) of Pennsylvanian shales, and often is divided into two distant aquifers, the upper and the lower, by the shales of the Warsaw Formation. Carbonate rocks are the major water-yielding material in the aquifer.

2.0233 Recharge to the Mississippian aquifer is from precipitation. Yield to individuals wells in both the upper and lower portions is less than 20 gpm.

2.0234 The Devonian aquifer is composed mostly of carbonate rocks with some gypsum and anhydrites present. In areas where the gypsum and anhydrites are present, they are major factors influencing the chemical quality of the water. The Devonian aquifer is separated by a thick predominantly shale interval between it and the Mississippian aquifer above.

2.0235 Local precipitation has little effect on water in the Devonian aquifer. Data on the yield to individual wells and the quality of water in the aquifer is not available for Wapello County.

2.0236 The Cambrian-Ordovician aquifer is below the Devonian aquifer and is separated from the Devonian by thick shale and dolomite layers. This aquifer is predominantly dolomite, however, two sandstone units occur within the sequence. The lower one, the Jordon Sandstone, is the principal water-bearing unit in the aquifer.

2.0237 Potential recharge to the Cambrian-Ordivician aquifer is more than 100 miles from southeast Iowa and is not sufficient to replenish the present withdrawals. As a result, the piezometric surface has depressed 25 to 75 feet, and will be lowered further as withdrawals continue. Yield to individual wells in this aquifer vary from 500 to 1000 gpm.

2.0238 The alluvial aquifer underlying the flood plain of the Des Moines River as shown by borings is composed of sands and in some locations significant portions of fine material. Overlaying these sands is 9 to 12 feet of clayey soil.

2.0239 Recharge to the alluvial aquifer of the Des Moines River is from precipitation. Yield to individual wells in the aquifer should be in the order of 100 gpm. The quality of the water in the aquifers listed above can be approximated from the chemical characteristics of ground water resources listed in Table 2-2.

2.024 Water Use. Water withdrawals from surface water sources in Wapello County for 1967-1968 were as follows (in mgd): farm ponds-0.27; streams-5.22; alluvium-0.13.

2.0241 During the sampling period the following withdrawals of ground water were made: glacial drift and buried channels-0.56; shallow bedrock-0.30; Cambrian-Ordovician-5.91. The total withdrawn from all sources was 12.39.

2.0242 The largest single location of withdrawals was at Ottumwa where municipal supply was withdrawn from the Des Moines River and where industry withdrew the largest portion of withdrawals from the Cambrian-Ordovician aquifer. In 1966-1967 Ottumwa's withdrawals amounted to 10.08 mgd. Total withdrawals in Wapello County average only 12.39 mgd for the period.

2.0243 The Iowa Natural Resources Council is responsible for the allocation of water resources within the state. Table 2-4 lists permits which have been issued for withdrawal of water from the Des Moines River Basin between Lake Red Rock and Ottumwa, Iowa. Pending applications for permits to withdraw water are also shown.

2.0244 The Iowa Natural Resources Council together with the U.S. Corps of Engineers currently are conducting studies concerning the allocation of water including the Des Moines River. Ultimately, the Natural Resources Council will make a decision on the permit application for the Ottumwa Generating Station.

Table 2-4

REGULATED STREAM WITHDRAWALS IN THE DES MOINES RIVER BASIN BETWEEN LAKE RED ROCK AND OTTUMWA, IOWA

Name	Permit No.	County	Location[a]	Source	Type of Use	Annual Amount Authorized (acre-feet)	Maximum Withdrawal Rate (cfs)	Withdrawal Period
A. Existing Permits								
1. Iowa Southern Utilities (Bridgeport Station)	578-R1	Wapello	7-73-15	Des Moines River	Power Production	1,726	6.7	Jan. 1 - Dec. 31
2. Material Service, Inc.	2291	Wapello	23-72-14	Des Moines River	Sand & Gravel Production	600[b]	4.5	Apr. 1 - Nov. 15
3. Durham Quarry, Inc.	2974	Marion	29-76-18	Des Moines River	Irrigation	240	4.5	Apr. 1 - Oct. 1
B. Pending Applications								
1. Iowa Southern Utilities (Ottumwa Station)		Wapello	26-73-15	Des Moines River	Power Production	14,499	20	Jan. 1 - Dec. 31
2. Pella Sand & Gravel Company		Marion	3-75-18	Des Moines River	Sand & Gravel Production	2,099[b]	13.4	Mar. 1 - Dec. 15

[a] Location given as section-township-range.

[b] Water use is basically non-consumptive.

Source: Iowa Natural Resources Council, June 1976.

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U.S. Army Corps of Engineers, March 17, 1975, Transmitted to B&V in a written communication.

2.03 Meteorology

2.031 Regional Climatology

2.0311 General. Iowa lies near the geographic center of the 48 contiguous states. It is primarily rolling prairie and is approximately equidistant from the Gulf of Mexico, the Atlantic Ocean, and the Hudson Bay at roughly 900 miles distance each. The Pacific Ocean is about 1300 miles west and the Rocky Mountains are approximately 500 miles west of Iowa. Iowa's climate is distinctly continental with a wide variety of weather extremes and marked seasonal variations. Oscillations and perturbations in the high level prevailing westerlies have an important affect on Iowa's weather. These high level features influence surface weather systems and cause surface winds to flow predominantly from either the south to southeast or the north to northwest. The southerly winds can draw warm air masses up from the Gulf of Mexico during the warm months of the year, producing a summer rainfall maximum. The prevailing northwesterly flow of Canadian air, during the winter, results in cold and relatively dry conditions. At intervals throughout the year, air masses from the Pacific Ocean move across the mountains to Iowa, producing comparatively mild and dry weather. Hot, dry winds, from the desert southwest, occasionally enter Iowa during the summer, resulting in unusually high temperatures and low humidities. As the surrounding terrain is low, there are no natural obstructions to the free sweep of air currents from all directions.

2.0312 Temperature. The average annual temperatures in Iowa range from 46F in the northern counties to 52F in the southeastern counties. The hottest month is July with an average daily maximum temperature of about 85F and a daily minimum in the lower sixties. January is the coldest month with daily maxima ranging from 24F to 34F, northern to southern counties, and the minima from 4F to 14F.

2.0313 Precipitation. Precipitation in Iowa ranges from 25 inches in the northwest to about 34 inches in the east and southeast with a state average of around 31 inches per year. The average annual snowfall varies from near 20 inches at Keokuk to as much as 45 inches over the northern counties. Drought occurs periodically in Iowa with the most severe cases of recent times occurring in the 1950's.

2.0314 Severe weather. Over 75 per cent of Iowa's 40 to 50 annual thunderstorms occur during the warmer half of the year. Occasionally they are accompanied by hail, high winds, heavy rains, and tornadoes. The probability of occurrence of thunderstorms is highest in late spring and early summer. Tornadoes occur most frequently in May and June in late afternoon and evening. Damaging hailstorms, reaching a maximum in early summer, average about 58 per year and destroy about one or 2 per cent of the major crops. The severe hailstorms occur more frequently over northwestern counties. Hail occurs, on the average, from two to six times a year, for any location. High winds at 15 feet reach 50 mph, sustained, in about half of the recorded years. Winds up to 75 mph, sustained, may be expected once in every 50 years at the 15 feet level[1].

2.0315 Dispersion Potential. The potential for atmospheric pollution buildup is dependent upon a number of meteorological factors, primarily, the mixed layer depth, wind speed within the mixed layer, and low level inversion frequency. These factors can impose impermeable boundaries and/or affect the rate that effluents are dispersed.

2.03151 Hosler [2] has tabulated the per cent frequencies of inversion and/or isothermal conditions, based below 500 feet above station elevation, for National Weather Service radiosonde stations in the contiguous United States. Data for a 10 year period were utilized for these computations. Interpolation between the stations allows estimation of inversion frequencies for the southeastern Iowa area. Table 2-5 presents estimates of inversion frequency obtained in the above manner.

2.03152 Takle et. al [3] have studied 6 years of data from a 32 meter tower located at Ames, Iowa and have presented monthly inversion frequencies which can be considered representative for most relatively flat rural areas in Iowa. These data have been averaged seasonally and annually and included in Table 2-5. General agreement exists between these data and the Hosler estimates. Differences may be due to smoothing and inaccuracies in interpolation of values derived from radiosonde data, problems with resolution of radiosonde data in the lowest 100 feet, and variability in average inversion duration for each occurrence.

2.03153 Due to the pronounced continental type climate of Iowa, inversion frequencies are closely related to the diurnal cycle; that is, there is a definite tendency for nocturnal stability and daytime instability at lower levels in the atmosphere.

2.03154 Holzworth [4] has supplemented the work of Hosler by estimating mean mixing depths and average wind speeds within the mixed layer, again, at National Weather Service radiosonde stations. The mixing depth is defined as the height above the surface at which an air parcel, when raised from the surface in a dry adiabatic manner, is at the same temperature as it's surroundings. Below this level relatively vigorous mixing occurs. Diffusion above this height is strongly inhibited due to thermal buoyancy considerations. Table 2-6 presents values of seasonal and annual morning and afternoon mixing depths and wind speeds for the southeastern Iowa region. The

Table 2-5

INVERSION FREQUENCIES IN IOWA

	Southeastern Area[a]		Central Area[b]	
	Per Cent of Total Hours	Average Days Per Period	Per Cent of Total Hours	Average Days Per Period
Winter[c]	37	58	18	57
Spring	30	64	25	76
Summer	30	74	34	90
Fall	38	59	35	81
Annual	34	240	28	304

---

[a] Inversions based below 500 feet; from (2)

[b] Inversions based below 105 feet; from (3)

[c] Winter is taken as Dec., Jan., and Feb.; Spring as Mar., Apr., and May; etc.

Table 2-6

MIXING DEPTHS AND LOW LEVEL WINDS IN SOUTHEASTERN IOWA[a]

	Morning		Afternoon	
	Mixing Depth feet	Wind Speed mph	Mixing Depth feet	Wind Speed mph
Winter	1300	14.5	1975	16.8
Spring	1575	15.7	4600	20.4
Summer	1150	11.0	5400	14.5
Fall	1300	12.3	3925	16.1
Annual	1300	13.4	3925	17.0

---

[a] From Reference 4.

potential for air pollution buildup is greatest when the mixing depths and wind speeds are both low.

2.03155 The morning mixing depth values from Table 2-6, in general, reflect the morning breakup of the nocturnal inversion. The existence of low mixing depths and nocturnal inversions does not necessarily lead to pollutant buildups. Proper release heights need to be carefully considered; further details regarding this are included in the following section (2.0328).

2.032 Local Meteorology

2.0321 General. The Ottumwa plant site is in southeastern Iowa and, therefore, tends to have higher maximum and minimum temperatures and greater precipitation than elsewhere in the state. The plant site is within 10 miles of the two Ottumwa meteorological substations. One is inside the Ottumwa city limits and records mainly precipitation data, and one is outside the city at the Ottumwa municipal airport and is operated by the Federal Aviation Admininstration (FAA). This second substation records wind, precipitation, and temperature data. When information is needed that these two substations do not record, the data from other substations in the area or the first order station at Des Moines will be used. Des Moines is approximately 65 miles to the northeast of the plant site.

2.0322 Temperature. Temperatures for the Ottumwa site definitely reflect the strictly continental climate of the area as evidenced by their wide seasonal variance. Table 2-7 displays normals, means and extremes for the Des Moines area. The trends shown in the table hold for the Ottumwa area, although extremes can vary. For example, for the period 1950 to 1974 an extreme of 103F was recorded on July 27, 1956, for the site area and a low of -31F was recorded on January 14, 1957.

2.0323 Humidity. Like most states on the Great Plains, Iowa is a fairly humid area. As shown in Table 2-7 humidity is usually between 60 and 80 per cent, reaching its peak very early in the day and decreasing in value as the day progresses.

2.0324 Wind and storms. Figures 2-13 and 2-14 show annual wind distributions for Des Moines and Ottumwa, respectively. The major difference between the two figures is apparent; an observer bias against the reporting of wind directions from the NNE, ENE, ESE, etc. seems to exist at Ottumwa. The general patterns are similar, however, with a large portion of the winds from the southerly and northwesterly directions. The period of record for the Des Moines data, being longer and more recent than that for Ottumwa, is probably more representative of the actual conditions which exist over southeast

TABLE 2-7

NORMALS, MEANS, AND EXTREMES

Month	Temperature							Normal heating degree days (Base 65°)	Precipitation												Relative humidity				Wind &					Pct. of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days											Average daily solar radiation - langleys
	Normal			Extremes #												Snow, Ice pellets					Hour 00	Hour 06	Hour 12	Hour 18			Fastest mile					Sunrise to sunset							Temperatures Max.		Min.		
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year		Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	(Local time)				Mean speed	Prevailing direction	Speed	Direction	Year			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog	90 and above ‡	32 and below	32 and below	0 and below	
(a)	(b)	(b)	(b)	10		10		(b)	(b)	31		31		31		31	31		31		9	9	9	9	21	19	20	20		20	21	21	21	21	31	31	31	21	9	9	9	9	
J	28.5	11.3	19.9	62	1967	-24	1970	1398	1.30	4.38	1960	0.07	1934	2.97	1960	8.1	19.8	1942	19.8	1942	79	80	73	73	11.7	NW	66	NW	1953	51	6.7	8	6	17	7	2	*	2	0	20	30	9	
F	32.2	14.6	23.4	65	1967	-16	1962	1165	1.10	2.99	1951	0.13	1968+	1.77	1961	6.5	21.3	1962	12.1	1950	79	81	69	68	11.8	NW	56	W	1952	55	6.3	8	6	14	7	2	*	3	0	14	27	4	
M	42.9	24.6	33.8	83	1968+	-22	1962	967	2.09	5.37	1961	0.51	1956	2.42	1965	7.7	18.8	1948	8.9	1957	76	81	65	61	13.3	NW	66	S	1953	55	6.8	7	7	17	10	2	2	2	0	6	24	*	
A	59.4	38.0	48.7	90	1970	15	1970	489	2.53	6.11	1947	1.05	1942	2.05	1945	1.2	6.2	1959	6.2	1959	72	80	59	55	13.5	NW	76	W	1965	59	6.7	7	7	16	10	*	4	1	*	0	7	0	
M	71.4	49.8	60.6	98	1967	30	1967	211	4.07	7.53	1960	1.23	1949	2.79	1954	T	0.2	1944	0.2	1944	72	79	57	53	11.9	SE	70	W	1955	60	6.5	7	9	15	11	0	7	1	1	0	*	0	
J	81.3	60.7	71.0	99	1970	42	1969	39	4.71	14.19	1947	1.13	1963	5.50	1947	0.0	0.0		0.0		76	82	59	56	10.7	S	76	NW	1953	66	6.0	7	11	12	11	0	10	1	3	0	0	0	
J	87.3	65.2	76.3	100	1966	48	1967	0	3.06	10.51	1958	0.42	1967	5.14	1958	0.0	0.0		0.0		77	83	58	57	9.1	S	73	W	1968	72	5.4	10	12	9	9	0	9	1	8	0	0	0	
A	84.7	63.4	74.1	100	1964	45	1967	9	3.67	10.47	1954	0.71	1953	3.2[illegible]	1960	0.0	0.0		0.0		79	86	58	58	8.9	S	60	SSE	1960	71	5.2	11	10	10	9	0	7	1	5	0	0	0	
S	76.9	53.8	65.4	93	1961	32	1965	99	2.88	10.19	1961	0.41	1950	4.4[illegible]	1961	T	T	1942	T	1942	81	86	62	62	9.8	S	55	NW	1953	65	5.2	12	7	11	9	0	5	1	1	0	*	0	
O	65.7	42.6	54.2	95	1963	22	1969+	363	2.06	7.29	1941	0.03	1952	2.81	1947	0.1	2.4	1967	2.4	1967	71	78	54	56	10.8	S	56	W	1952	64	5.1	12	8	11	7	*	3	1	*	0	5	0	
N	46.5	27.6	37.1	76	1965+	-3	1964	837	1.76	4.60	1952	0.03	1969	3.35	1952	2.0	13.5	1968	11.8	1968	75	79	63	66	12.0	NW	72	W	1952	51	6.3	8	7	15	6	1	1	2	0	3	18	*	
D	33.5	17.0	25.3	66	1970	-16	1963	1231	1.14	2.90	1941	0.22	1946	1.24	1941	6.1	23.9	1961	11.0	1961	78	80	70	70	11.8	NW	61	SW	1951	46	6.8	7	7	17	7	2	*	3	0	15	28	3	
YR	59.2	39.1	49.2	100	JUL. 1966+	-24	JAN. 1970	6808	30.37	14.19	JUN. 1947	0.03	NOV. 1969+	5.50	JUN. 1947	31.7	23.9	DEC. 1961	19.8	JAN. 1942	76	81	62	61	11.3	NW	76	W	APR. 1965+	60	6.1	104	97	164	103	10	50	18	18	58	140	17	

For period July 1961 through the current year.
Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows:
Highest temperature 110 in July 1936 and earlier; lowest temperature -30 in January 1884; maximum monthly precipitation 15.79 in June 1881; maximum monthly snowfall 37.0 in January 1886.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological standard normals (1931-1960).
* Less than one half.
+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
Below zero temperatures are preceded by a minus sign.
The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.
‡ ≥ 90° at Alaskan stations.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

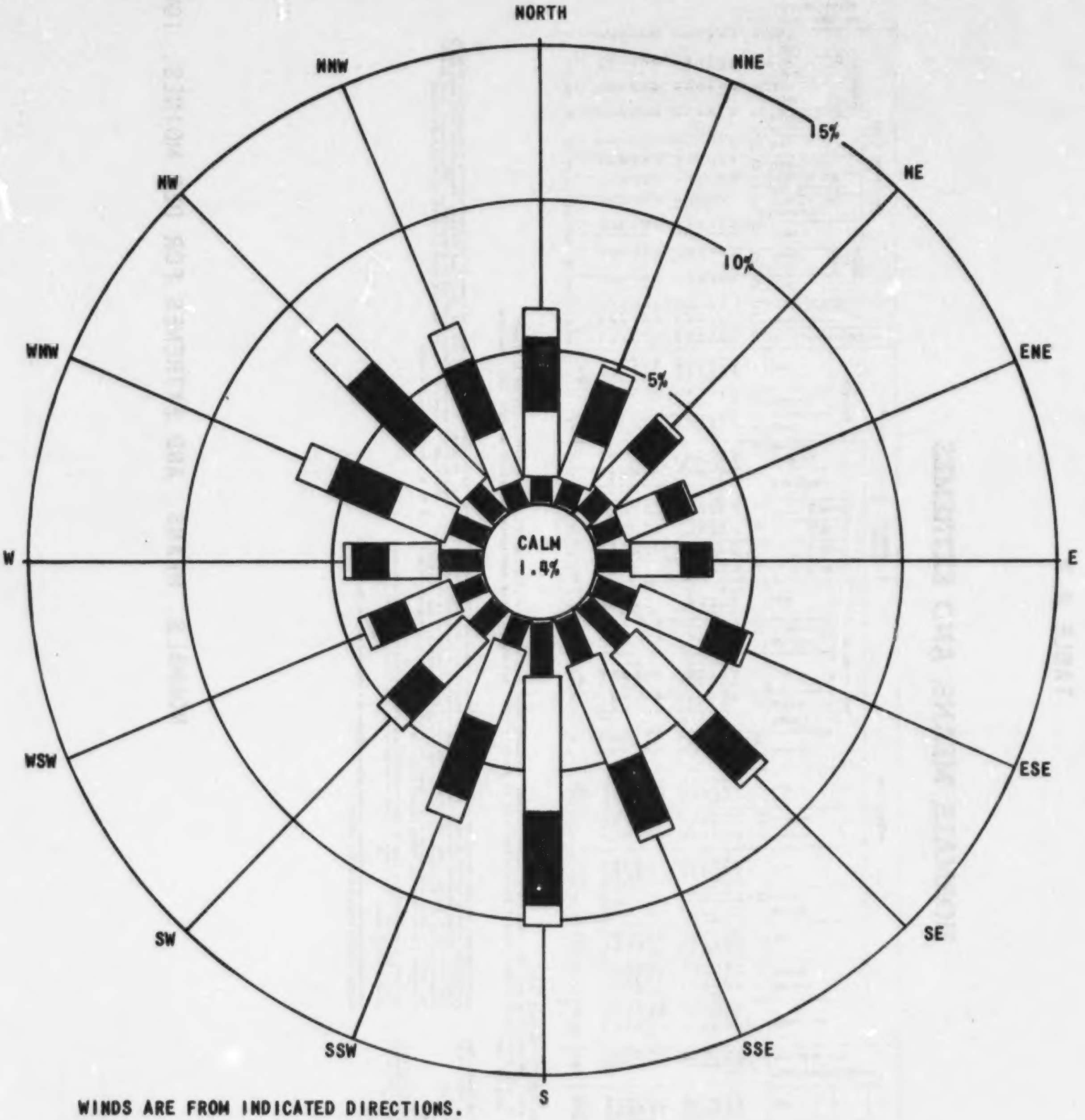
Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

& Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

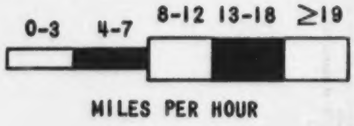
To 8 compass points only.

NORMALS, MEANS, AND EXTREMES FOR DES MOINES, IOWA

FIGURE 2-13



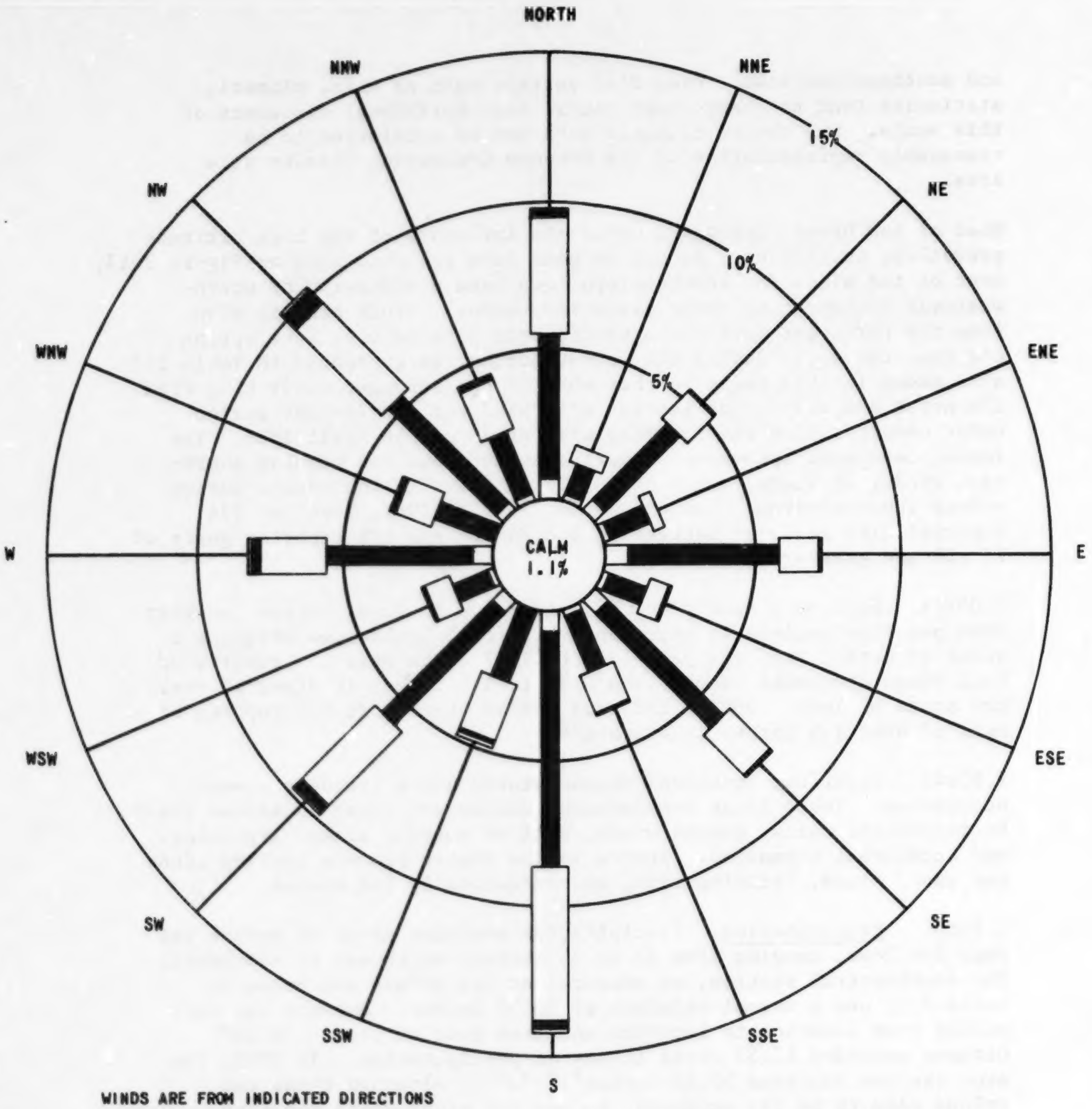
WINDS ARE FROM INDICATED DIRECTIONS.
PERIOD OF RECORD: 1951 THROUGH 1960



ANNUAL WIND ROSE
DES MOINES, IOWA

REFERENCE:
WEATHER BUREAU, DECENNIAL CENSUS OF THE UNITED STATES CLIMATE - SUMMARY OF HOURLY OBSERVATIONS, 1951-1960, UNITED STATES DEPARTMENT OF COMMERCE, DES MOINES, IOWA

FIGURE 2-14



WINDS ARE FROM INDICATED DIRECTIONS

PERIOD OF RECORD: 1943 THROUGH 1945

0-3	4-12	13-24	25-31	≥ 32

MILES PER HOUR

ANNUAL WIND ROSE
OTTUMWA, IOWA

REFERENCE:

NATIONAL CLIMATIC CENTER, FEDERAL BUILDING, ASHEVILLE, N.C.
(UNPUBLISHED SUMMARY)

and southcentral Iowa. Over flat terrain such as this, climatic statistics tend to change very little over horizontal distances of this scale. Des Moines climatic data can be considered to be reasonably representative of the Ottumwa Generating Station site area.

Most of the Great Plains are under the influence of the high altitude prevailing westerlies. As can be seen from the wind rose on Figure 2-13, most of the winds for southeastern Iowa have a southerly or northwesterly component to their direction vector. Winds tend to blow from the northwest during the period from late fall to late spring and from the south during the warmer months, as evidenced in Table 2-7; also shown in this table is that most of the stronger winds blow from the north and west. The fastest mile wind for the 20-year period under consideration was from the west at 76 mph in April 1965. The lowest mean wind speeds occur during summer, but the highest short-term winds, or gusts, can and usually do occur in the summer during severe thunderstorms. For the period 1955 to 1967, Iowa had 274 reported wind gusts of between 58 and 74 mph and 121 reported gusts of 75 mph and greater[5].

2.03241 Hail is a fairly common occurrence in Iowa. Sizes can vary from pea size pellets to huge (and very rare) hailstones weighing a pound or more. From the year 1956 to 1967 there were 153 reports of hail whose diameters ranged from 0.75 to 1.5 inches in diameter over the state of Iowa. During the same period there were 123 reports of hail of over 1.5 inches in diameter[6].

2.03242 Powerful, localized thunderstorms are a frequent summer occurrence. These large cumulonimbus clouds can cause localized heavy to torrential rains, strong winds, hail of varying sizes, lightning, and occasional tornadoes. Storms in the winter produce howling winds and snow, sleet, freezing rain, and occasionally ice storms.

2.0325 Precipitation. Precipitation averages about 31 inches per year for Iowa, ranging from 25 to 34 inches, northwest to southeast. The southcentral section, as measured at Des Moines and shown in Table 2-7, has a normal rainfall of 30.37 inches. Amounts can vary widely from location to location and from year to year. In 1879 Ottumwa recorded 17.33 total inches of precipitation. In 1902, the same station recorded 50.59 inches[7,8,9,10]. Although these two values seem to be the extremes, values for other years approach them. Nearly two-thirds of the annual precipitation is measured from April through September, with rain occuring about 100 days per year. Snowfall averages about 20 inches in the southern portions of Iowa. The average date for the first one-inch snowfall is December 10 in the southeast portion of the state, with the first trace of snow falling about a month earlier. The possibility of snow for the season is usually over by April, but can extend into May.

2.0326 Fog. Weather data recorded at Des Moines for the period 1951-1960 indicates a fairly low occurrence of heavy fog. For the 10-year period, there was an average of 19 days per year of visibility of 2.5 miles or less, and an average of 6 days per year of visibility of less than three quarters of a mile[11].

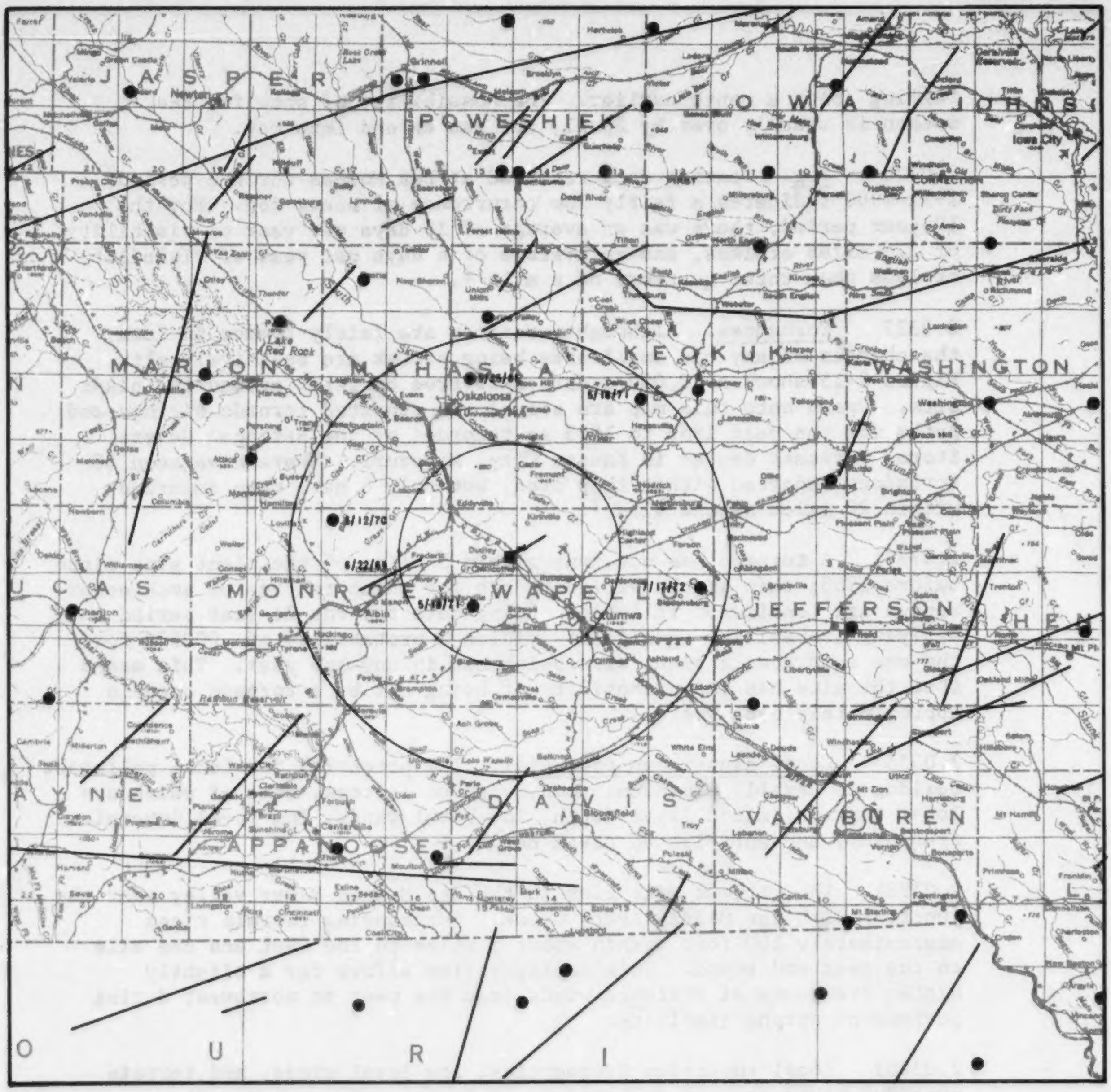
2.0327 Tornadoes. Although tornadoes are fairly common in Iowa, the chances of any one small area being struck are relatively slim. Figure 2-15 shows a 10,000 square mile area centered around the plant site. Drawn onto this map are all of the reported tornado sitings and paths for the year 1953 to 1973 as recorded by the National Severe Storms Forecast Center in Kansas City, Missouri. There have been 88 tornadoes reported within this area, but only 6 have been reported within 20 miles of the site[12].

2.03271 A tornado has not come within 5 miles of the plant site since before 1953; this is the earliest date for which records of such occurrences are considered reliable. Using data for the 21-year period and applying probability equations[13] yields a probability of .000509 for the one square mile plant site being hit in any one year. This means that the site has the probability of being hit by a tornado once in approximately 1966 years.

2.0328 Local dispersion potential. The potential for local pollutant buildup is usually dependent upon numerous factors, some of which are local terrain, mixed layer depth, low level winds, low level inversion frequency, and anticipated stack height.

2.03281 The Ottumwa site lies in the Des Moines River valley near the junction with the Middle Avery Creek. Surrounding terrain rises approximately 100 feet within about 2 miles to the west and one mile to the east and south. This configuration allows for a slightly higher frequency of drainage winds from the west to northwest during periods of strong stability.

2.03282 Local inversion frequencies, low level winds, and terrain considerations are not expected to be factors of great importance at the Ottumwa site if a stack of adequate height is incorporated into the design. A stack height of 600 feet has been assumed for dispersion calculations made in Section 4.022 of this report. Utilizing a worst case analysis with regard to emission rates, low level wind speeds and atmospheric turbulence (stability), it has been determined that ground level concentrations will not surpass the most stringent applicable ambient air quality standards.



——— TORNADO PATH

● TORNADO SITING

SCALE 1" = 14.2 MILES

TORNADO OCCURRENCES IN
SITE VICINITY FROM 1953 TO 1973

2.03283 The calculations referred to in the previous paragraph dealt with what might be called "normal" meteorological conditions. This is where the plume spreads in an unrestricted fashion both vertically and horizontally, except for the impermeable boundary represented by the ground. Conditions other than this occur during morning inversion breakup and with plume trapping beneath elevated inversion layers produced by stagnant high pressure areas. The number of days per year of stagnant conditions has been found to be very nearly zero for southeastern Iowa[14]. Morning inversion breakup can allow relatively high ground level concentrations for very short time periods (less than 30 minutes); however, these conditions are not expected to cause averages over longer time periods to exceed applicable standards.

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2.04 Economic and Social Factors

2.041 Introduction. The objectives of the economic and social portions of this report are to describe the region in which the proposed plant will be located, and to assess the impacts of the construction and operation of the Ottumwa Generating Station (OGS) on local economic and social activities. The purpose of this section is to accomplish the former objective and to lay the groundwork for accomplishing the latter by developing a base line ("without OGS") projection of selected economic and social variables from which impacts on these variables can be measured. These expected future values are developed through the use of both quantitative and qualitative analyses. Any impacts that OGS might have on future local economic and social activity are evaluated in subsequent sections of this report.

2.0411 Study areas. Four study areas have been defined for purposes of analyzing social and economic effects. County boundaries were used in establishing areas, primarily for expediency in gathering data but also to reflect the appropriate degree of accuracy with which impacts may be assigned to a geographic area. It should be emphasized that economic and social effects of OGS will not disperse uniformly in all directions and are unlikely to reach every small community and farmstead. The following study areas were chosen because selected OGS impacts will reliably occur within their boundaries.

2.04111 Station site. The actual Station Site consists of approximately 795 acres in Wapello County some 8 miles northwest of Ottumwa, Iowa on the west bank of the Des Moines River.

2.04112 Primary area. The Primary Area consists of Wapello, Mahaska, and Monroe Counties, Iowa.

2.04113 Secondary area. The Secondary Area includes the entire 28-county Iowa Southern Utilities service area outside the Primary Area.

2.04114 External area. All area beyond the Secondary Area is defined as the External Area. No quantification of External Area economic or social factors will be attempted, although benefits from material purchases and multiplier effects will occur.

2.0412 Projection methodology. In order to measure OGS-related impacts on economic activity in the Primary Area, projections of certain socio-economic variables were made for "with OGS' and "without OGS" levels of economic activity. These projections were developed through the use of an econometric model of the Primary Area, which was derived from historical relationships exhibited by these variables. Only the projections themselves are discussed in the body of this report. For further explanation and interpretation of the econometric model and its results refer to Appendix F. The balance of this section pertains to historical data and "without OGS" projections. Subsection 4.0120 discusses "with OGS" projections and OGS-related socioeconomic impacts.

2.042 Economic Setting. The objectives of this section are to describe the existing status of certain economic variables in the Station Site and Primary Area, and to project development of these same variables in the Primary Area without OGS. Table 2-8 lists the the impact areas and the economic variables which are evaluated in each impact area. The bases for choosing and discussing variables are generally accepted economic theories and historical experience concerning construction and operation of large electric energy generating stations.

2.0421 Population and population density. Population of the Primary Area[1,2,3,4] has declined steadily since 1950, both in actual numbers and as a percentage of total Iowa population. Population density in the Primary Area has also declined some 16 per cent since 1950, while population density in the State of Iowa has increased about 10 per cent during the same period (See Appendix G, Table G-1). Population density (population per square mile) for each county in the Primary Area was used in lieu of total population in order to eliminate the effects of variances in county sizes. Population projections with OGS were derived from the Iowa Development Commission's county estimates[5]. These projections, shown in Table 2-9, amount to a .46 per cent compound annual growth rate over the 35-year period from 1975 to 2010.

2.0422 Labor force and employment characteristics. Section 2.0422 discusses historical and projected "without-OGS" levels of total labor force, employment, unemployment rate, and the real wage rate in the Primary Area.

2.04221 Total labor force. Total labor force data includes employed persons and those without jobs who consider themselves part of the labor force. The data shown in Table 2-9 indicates that the total labor force has decreased during the 25 year historical study period and has maintained a nearly constant relationship with total population. Projections of the total labor force are also presented in Table 2-9. As in the case of population, the total labor force is expected to increase.

2.04222 Employment/unemployment rate. Historical employment data in the Primary Area[6] is shown in Table 2-9 along with the unemployment

Table 2-8

ECONOMIC VARIABLES CONSIDERED BY GEOGRAPHIC AREAS

Station Site	Primary Region	Secondary Area
Public Facilities	Population	Ad Valorem Taxes
Public Services	Population Density (No./Sq. Mi.)	
Ad Valorem Tax Revenues	Total Labor Force	
Cropland Removed from Production	Employment	
	Unemployment Rate	
	Personal Income	
	Wages and Salaries	
	Property and Proprietor Income	
	Real Wage Rate	
	Land in Farms	
	Number of Farms	
	Average Size of Farms	
	Value of Farmland Land and Buildings	
	Farm Income	
	Retail Sales	
	Business Index	

Table 2-9

PRIMARY AREA
HISTORICAL ECONOMIC DATA AND PROJECTED ECONOMIC ACTIVITY WITHOUT OGS

Year	Population[a] #	Population Density[a] #/SQ MI	Total Labor Force[b] #	Employment[b] #	Unemployment Rate[b] %	Real Wage Rate[c] $/HR	Personal Income[b] $1,000	Wages and Salaries[b] $1,000
1950	89,500	62.0	31,919	30,609	4.1	1.26	223,646	77,144
1955	81,700	56.6	31,670	30,366	4.1	2.05	258,779	124,493
1960	80,200	55.5	31,651	30,387	4.0	2.66	302,748	161,477
1965	79,200	54.8	30,171	29,120	3.5	3.40	373,575	198,037
1970	72,100	49.9	29,910	28,370	5.1	3.63	399,114	205,768
1974	75,000	51.9	28,980	28,270	5.7	3.84	437,527	216,982
1975	76,774	53.2	31,222	29,849	4.4	4.08	464,412	243,836
1976	77,140	53.4	31,798	30,412	4.4	4.06	470,665	246,793
1977	77,521	53.7	32,374	30,975	4.3	4.03	476,917	249,750
1978	77,895	53.9	32,950	31,538	4.3	4.01	483,170	252,707
1979	78,268	54.2	33,527	32,102	4.3	3.98	489,422	255,664
1980	78,642	54.5	34,103	32,665	4.2	3.96	495,675	258,622
1981	79,015	54.7	34,679	33,228	4.2	3.94	501,927	261,579
1985	80,510	55.8	36,984	35,481	4.1	3.85	526,937	273,407
1990	82,378	57.0	39,865	38,298	3.9	3.76	558,199	288,193
1995	84,245	58.3	42,746	41,114	3.8	3.68	589,461	302,979
2000	86,113	59.6	45,627	43,930	3.7	3.62	620,723	317,765
2005	87,981	60.9	48,508	46,746	3.6	3.56	651,985	332,551
2010	89,849	62.2	51,390	49,563	3.6	3.50	683,246	347,337

Year	Profit and Proprietor Income[b] $1,000	Disposable Income[a]	Transfer Payments[b] $1,000	Contributions to Special Insurance[b] $1,000	Farm Income[b] $1,000	Land in Farms[d] Acres	Number of Farms[d] #	Average Size of Farms[d] Acres/Farm
1950	129,253	198,131	19,646	2,397	44,849	893,660	5,938	150
1955	118,105	232,881	18,792	2,611	30,407	895,302	5,593	160
1960	121,606	274,982	24,868	5,173	30,539	896,219	5,270	170
1965	148,609	342,002	35,895	8,966	40,807	882,757	4,411	200
1970	151,186	365,606	55,084	12,923	31,943	835,125	3,721	224
1974	175,209	395,870	61,088	15,752	33,185	833,500	3,695	226
1975	175,285	426,041	61,888	16,597	39,417	835,206	3,604	231.7
1976	177,196	431,909	63,947	17,272	39,762	832,360	3,515	236.8
1977	179,107	437,777	66,006	17,946	40,108	829,514	3,426	242.1
1978	181,018	443,646	68,065	18,621	40,453	826,668	3,339	247.6
1979	182,929	449,514	70,124	19,295	40,798	823,822	3,252	253.3
1980	184,840	455,382	72,183	19,970	41,144	820,976	3,167	259.2
1981	186,751	461,250	74,242	20,645	41,489	818,130	3,082	265.4
1985	194,395	484,724	82,478	23,343	42,871	806,746	2,753	293.0
1990	203,950	514,066	92,722	26,716	44,597	792,517	2,358	336.1
1995	213,504	543,408	103,067	30,089	46,324	778,287	1,977	393.7
2000	223,059	572,749	113,361	33,462	48,051	764,057	1,606	475.4
2005	232,614	602,091	123,656	36,835	49,778	749,827	1,244	602.8
2010	242,168	631,432	133,950	40,208	51,505	735,597	888	828.4

Sources:
(a) Sales Management Magazine, Annual Survey of Business Issues, 1949-74.
(b) Bureau of Economic Analysis, Regional Economic Information System, Department of Commerce.
(c) Calculated from deflated wage and salaries, employment and 2,000 hour annual average per employee.
(d) Iowa Department of Agriculture, Iowa Crop and Livestock Reporting Service.

Table 2-9 (Continued)

Year	Real Estate Value Per Sq. Mile $1,000/Mi²	Personal & Public Service Valuation(e) $1,000	State Sales Taxes(f) $1,000	Federal Income Taxes(i) $1,000	State Income Taxes(i) $1,000
1950	52.08	25,607	3,786	23,790	1,725
1955	57.82	34,301	4,190	24,352	1,546
1960	63.53	39,530	3,872	25,866	1,900
1965	67.91	42,322	4,115	28,636	2,937
1970	78.90	36,266	6,348	29,533	3,975
1974	89.36	36,866	6,293	32,098	9,559
1975	92.5	39,080	6,432	32,290	6,082
1976	95.9	38,923	6,545	32,538	6,218
1977	99.3	38,739	6,657	32,786	6,354
1978	102.9	38,526	6,770	33,034	6,490
1979	106.6	38,205	6,883	33,282	6,626
1980	110.5	38,014	6,996	33,530	6,763
1981	114.6	37,712	7,109	33,778	6,899
1985	132.4	36,165	7,560	34,770	7,443
1990	159.0	33,375	8,125	36,009	8,124
1995	191.3	29,448	8,689	37,249	8,804
2000	230.4	24,151	9,254	38,489	9,485
2005	277.8	17,201	9,818	39,729	10,165
2010	335.2	8,255	10,382	40,969	10,846

Year	Assessed Value of Farm Land & Buildings(e) $1,000	Avg. Assessed Value of Farm Land & Buildings(e) $/Acre	Retail Sales(f) $1,000	Business Index(g)	Bank Deposit(h) $1,000	Assessed Property Valuation(e) $1,000	Real Estate Valuation(e) $1,000
1950	25,016	27.99	196,808	80.5	126,405	100,809	75,201
1955	33,885	37.85	201,433	86.6	123,846	117,795	83,491
1960	38,387	42.83	206,696	84.3	127,244	131,269	91,738
1965	42,168	47.77	212,124	101.3	170,751	140,385	98,062
1970	53,488	64.05	222,453	99.7	221,117	150,199	113,934
1974	53,565	70.26	234,071	130.9	286,647	165,897	129,030
1975	56,229	67.3	237,961	133.4	304,441	172,702	133,622
1976	58,847	70.7	239,038	135.2	310,670	177,336	138,413
1977	59,875	72.2	240,114	137.0	316,899	182,137	143,399
1978	60,904	73.7	241,191	138.8	323,128	187,112	148,586
1979	61,932	75.2	242,268	140.6	329,357	192,260	153,982
1980	62,960	76.7	243,342	142.4	335,586	197,610	159,596
1981	63,988	78.2	244,422	144.2	341,815	203,146	165,434
1985	68,101	84.4	248,730	151.4	366,731	227,382	191,217
1990	73,241	92.4	254,114	160.4	397,876	263,013	229,638
1995	78,382	100.7	259,499	169.4	429,022	305,706	276,258
2000	83,523	109.3	264,883	178.4	460,167	356,917	332,766
2005	88,663	118.2	270,268	187.4	491,312	418,409	401,208
2010	93,804	127.5	275,653	196.4	522,457	492,307	484,052

Sources:
(e) Iowa Department of Revenue, Research and Statistics Division, Personal Correspondence J. Hibbs, May 28, 1975, annual value 1950-1974.
(f) Iowa Department of Revenue, Retail Sales and Use Tax, 1950-1974.
(g) Business Conditions Digest, Services 811, Composite index of 12 leading indicators.
(h) Federal Reserve Bank of Chicago.
(i) Iowa Department of Revenue, Personal Correspondence.

rate derived from total labor force and unemployment[6]. Total employment in the Primary Area has decreased over the historical study period, 1950 to 1975. As a result of the projected decreases in the total labor force and expected increases in employment, the unemployment level is expected to decrease.

2.04223 Real wage rate. The real wage rate is defined as total deflated wages and salaries (in 1981 dollars) divided by total employment expressed in man-hours. It is assumed that each man-year of employment is equivalent to 2000 man-hours. Substantial increases in the real wage rate over the 25-year study period are explained by greater increases in wages and salaries than in hours of employment, given the above productivity assumption (2000 man-hours/year). Projected real wage rate levels without OGS are calculated from projected wages and salaries and employment. As shown in Table 2-9, increases in the real wage rate indicate real increases in earning power (the effects of inflation having been removed).

2.0423 Income levels. This subsection contains historical and "without-OGS" projections of personal income, disposable income, wages and salaries, profit and proprietor income, transfer payments, personal contributions to social insurance, and farm income.

2.04231 Personal income. Historical personal income in the Primary Area[7], as shown in Table 2-9, is defined as wage and salary disbursements, other labor income, profit and proprietor income, and transfer payments less personal contributions for social insurance. The historical personal income series in Table 2-8 is derived from Bureau of Economic Analysis data[7] and deflated to 1981 dollars. The derivation of the 1981 series price deflators is explained in Appendix F. Real personal income has grown at a compound annual rate of approximately 3 per cent during the 25-year historical study period, while real personal income per capita has grown at slightly more than 3.5 per cent. Historically, income per capita in the Primary Area has been slightly below the state-wide level (see Appendix G, Table G-1). The personal income (PY) projections shown in Table 2-9 are derived using projections of their components in the following identity.
PY = WS + PRY + TR - SI
Projected levels of these components--wages and salaries (WS), profit and proprietor income (PRY), and transfer payments (TR) less contributions for social insurance (SI)—are discussed in the following sections.

a. Wages and salaries. Historical wage and salary payments in the Primary Area[7], as shown in Table 2-9, include income paid to labor including employee bonuses, commissions, payments in kind, and tips. These data, a major component of personal income, are highly correlated to employment levels and reflect variations in activity of both export and residentiary base industries. Historical wage and salary payments have grown at a compound rate slightly greater than 4 per cent from 1950 to 1974. Wages and salaries have constituted a steadily increasing share of total personal income in the Primary Area. In 1974, wage and salary payments represented about 53 per cent of personal income. Estimated future wage and salary payments shown in Table 2-9 are expected to continue to constitute one-half or more of total personal income. This relationship may be interpreted as maintenance of the current real income distribution and constitutes a desirable balance among income earning groups in the Primary Area.

b. Profit and proprietor income. Historical Primary Area profit or property income[7] consists of dividends, interest, and net rents accruing to persons. Proprietor income is the income derived from unincorporated enterprises such as proprietorships, partnerships, and producer's cooperatives. The sum of these two variables is presented in Table 2-9. This total, in terms of constant 1981 dollars, has grown at a compound annual rate slightly greater than one per cent over the historical study period. Projected Profit and Proprietor Income, excluding any effects of OGS, is presented in Table 2-9. The values shown are expressed in constant 1981 dollars so that fluctuations due to price changes in the economy have been eliminated and the projected levels reflect real increases and decreases. It is expected that Profit and Proprietor Income will increase over time.

c. Transfer payments and contributions to social insurance. Historical transfer payments in the Primary Area[7], as shown in Table 2-9, constitute a gradually increasing share of total personal income. Deflated transfer payments, defined as income paid to residents by federal and state agencies for which no goods or services are currently received in return, represented 13 per cent of total personal income in 1974. The historical relationship between transfer payments and personal income is expected to remain stable over time. Personal contributions to social insurance[7], as shown in Table 2-9, are subtracted from other income sources to obtain total personal income. Social insurance contributions are determined by personal income, up to a certain level, and constitute an increasing share to be subtracted from personal income. These contributions totalled about 3.5 per cent of personal income in 1974. Projected personal contributions to social insurance are shown in Table 2-9.

2.04232 Farm income. Farm Income[7] is composed of farm proprietors income and farm wages and salaries. These data include government payments to farmers under soil conservation, price guarantees and subsidies, and other government programs. Historical and projected levels of farm income appear in Table 2-9. Projected values of this variable were derived from sources outside the econometric model of the Primary Area.

2.0424 Agricultural land use. This subsection contains historical and "without-OGS" projections of land in farms, number of farms, average size of farms, value of farmland and buildings, and average value of farmland and buildings.

2.04241 Land in farms, number of farms, and average size of farms. Historical data concerning this portion of the farm sector in the Primary Area is shown in Table 2-9. Land in farms and total number of farms have been decreasing during the study period[8]. This trend is consistent with historical state-wide experience. Average size of farms in number of acres, defined as land in farms divided by number of farms, has been increasing, which is also consistent with the Iowa state trend. Projected levels of these variables without OGS are shown in Table 2-9. Past trends in these three variables are expected to continue. These trends, along with projected increases in farm income, suggest more intensive use of farmland as the amount of farmland increases.

2.04242 Value and average value of farmland and buildings. Value of farmland and buildings is determined by the demand for land and buildings, which in turn depends upon the productivity of the land, population density, and anticipated future economic conditions. The average value of farmland and buildings is simply the assessed value divided by the acreage in farms. Data for the historical and projected assessed valuation of farmland and buildings[9] and average assessed valuation per acre are presented in Table 2-9. The data shown for these two variables are in current dollars (not constant 1981 dollars). During the 25-year historical study period the assessed valuation of farmland and buildings has grown at a compound rate of about 3.5 per cent while the average value per acre increased at an approximate rate of 3.75 per cent. The upward trend in assessed valuation of farmland and buildings is expected to continue through both the construction and operation phases of OGS.

2.0425 Industrial and business activity. This subsection contains historical data and "without-OGS" projections of retail sales, the business index, and bank deposits.

2.04251 Retail sales. Historical and projected retail sales are presented in Table 2-9. The data shown are for net taxable retail sales (i.e., the dollar volume of nonexempt goods and services sold each year) and are expressed in constant 1981 dollars. Historically, retail sales have grown at approximately a one per cent compound annual rate since 1950. It is expected that growth consistent with past trends will be experienced in future levels of this variable.

2.04252 Business index. The U.S. business index[12], as shown in Table 2-9, is Series 811 from Business Conditions Digest. This series is a composite of 12 leading indicators in the U.S. economy before reverse trend adjustment. This variable was projected by linear time-series regression. Projected levels of the business index appear in Table 2-9.

2.04253 Bank deposits. Historical deflated bank deposits in the Primary Area[13], as shown in Table 2-9, have grown at a 3.25 compound annual rate over the historical period, 1950-1974. Bank deposits, which are indicators of local business activities, depend on disposable income (personal income after taxes) and the business index. Projected bank deposits are also presented in Table 2-9. Continued growth is anticipated, but at a rate slightly lower than in the past.

2.0426 Real estate sector. This section contains data concerning historical and projected total assessed property valuation, real estate valuation, real estate valuation per square mile, and personal and public service property valuation.

2.04261 Total assessed property valuation. Historical levels of assessed property valuation[9] in the Primary Area appear in Table 2-9. These historical levels were calculated by summing historical real estate valuation and personal and public service valuation. These assessed property valuation data were not converted to 1981 dollars since property valuations are not subject to annual price fluctuations in the same manner as other monetary variables. Projected levels of assessed property valuation, shown in Table 2-9, were estimated from their historical relationship with real estate valuation and time. Since 1950 the assessed property valuation in the Primary Area has grown at a compound annual rate of approximately 2 per cent. It is expected that without OGS similar growth trends will be experienced in future years.

2.04262 Real estate valuation and valuation per square mile. Historical real estate valuation in the Primary Area[9] generally constitutes the greater part of total assessed property valuation as shown in Table 2-9. Real estate valuation per square mile is calculated by dividing real estate valuation in each county by number of square miles and is employed in order to eliminate the effects of variation in the size of counties, thereby allowing comparison of valuations among counties in the Primary Area. Projected levels of real estate valuation derived from projected real estate valuation per square mile are also shown in Table 2-9. Historical real estate valuation has grown at an approximate compound annual rate of 2 per cent. Projected levels of this variable indicate a pattern of growth similar to that experienced during the 25-year historical study period.

2.04263 Personal and public service property valuation. Historical levels of personal and public service property valuation[9], as shown in Table 2-9, are the second and generally smaller component of total assessed property valuation. This variable includes tangible individual personal property, business and professional personal property, and utility property assessed by the Iowa State Department of Revenue. Projected levels of personal and public service property valuation without OGS are calculated directly by subtracting real estate value from total property value. Personal and public service property valuation projections appear in Table 2-9.

2.0427 Government revenues. This subsection discusses historical and projected "without-OGS" levels of state retail sales tax revenues, federal income tax revenues, and state personal income tax revenues.

2.04271 Retail sales taxes. Historical deflated retail sales tax revenues[14], as shown in Table 2-9, are the dollar volume collected by the State of Iowa through retail sales tax collections. These data are aggregated to correspond to the three-county Primary Area and have grown at a slightly higher rate than taxable retail sales due to periodic increases in the rate of taxation during the historical study period. Projected retail sales tax revenues which appear in Table 2-9 are based on their estimated relationahip to retail sales and time. Future levels of retail sales taxes are projected to increase in a manner consistent with historical trends.

2.04272 Federal and state income taxes. Historical federal and state income tax revenues collected in the Primary Area[9] are shown in Table 2-9. The Primary Area has provided an average of 2.57 per cent of total Iowa State income tax collections from 1950 to 1974.

2.043 Community Profile/Public Facilities and Services. The objectives of this section are identical to that of section 2.042, i.e. to describe the existing status of the area and project development in the area without OGS. This section, however, deals primarily with demographic factors which lend themselves to qualitative rather than quantitative analysis. Recent values for these factors can be found in Table 2-10. Indicators of the ability of the study areas to support growth are also considered in this section.

2.0431 Primary area. The character of the Primary Area is determined in this subsection through examination of population migration and composition, and population and income distribution. Public facilities and services considered include housing water and sewer capacities.

2.04311 Population in the three county (Mahaska, Monroe and Wapello) Primary Area declined approximately 8 per cent in the decade 1960 to 1970. This trend is opposite to that observed in Iowa and the

Table 2-10

SELECTED STATISTICS FOR VICINITY OF OGS

	Units	United States	Iowa	Primary Area[a]	Wapello County	City of Ottumwa
Population						
Total 1970	ea.	203,212,877	2,824,376	73,683	42,149	29,695
Change 1960-1970	%	13.3	2.5	(8.1)	(8.6)	(12.6)
Net Migration 1960-1970	%	1.7	(6.7)	(12.1)	(13.8)	out
Composition						
Sex - % female, 1970	%	51.3	51.4	52.2	52.7	53.7
Race - % caucasion, 1970	%	87.6	98.6	99.3	99.2	98.9
Age - 1970						
less than 5 years	%	8.4	8.2	7.1	7.1	7.1
5 through 17 years	%	26.0	26.5	24.7	25.4	24.5
18 through 64 years	%	55.7	52.9	52.6	52.9	53.2
65 years or more	%	9.9	12.4	15.6	14.6	15.2
Median age	yrs.	28.3	29.1	34.5	34.0	34.5
Education - 1970						
Population 25 yrs of age or more	ea.	109,899,359	1,540,588	43,498	24,787	17,594
Years of school completed						
less than 5 years	%	5.5	1.9	2.2	2.2	2.2
4 years of H.S. or more	%	52.3	59.0	50.9	50.6	51.8
4 years college or more	%	10.7	9.1	6.2	5.8	6.6
Median education	yrs.	12.1	12.2	12.0	12.0	12.1
Distribution						
Urban - 1970	%	73.5	57.2	61.2	70.5	100.0
Rural - 1970						
Farm	%	22.4	24.6	17.6	9.4	N.A.
Non-farm	%	4.1	18.2	21.2	20.1	N.A.
Income						
Families	ea.	51,168,599	717,776	19,776	11,241	7,939
Families with income:						
less than $3,000	%	10.3	10.1	14.0	11.9	11.1
$3,000 - $4,999	%	10.0	10.8	12.4	11.1	11.7
$5,000 - $6,999	%	11.9	13.4	14.4	13.6	13.3
$7,000 - $9,999	%	20.6	22.9	24.9	26.2	25.5
$10,000 - $14,999	%	26.6	26.6	23.5	25.7	26.5
$15,000 - $24,999	%	16.0	12.8	8.5	9.3	9.5
$25,000 or more	%	4.6	3.4	2.3	2.2	2.4
Median income	$	9,586	9,016	8,045	8,501	8,648
Below low income level	%	10.7	8.9	11.8	9.8	9.3
Housing						
Total year-round units - 1970	ea.	67,699,084	954,975	27,003	15,393	11,165
Change 1960 - 1970	%	19.9	7.4	(1.2)	(1.9)	(4.5)
Units built prior to 1950	%	53.5	69.8	78.3	74.2	76.1
Units built 1960 or later	%	25.0	16.9	10.5	11.6	8.9

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[a] Mahaska, Monroe and Wapello Counties.

Source: County and City Data Book - 1972, U.S. Bureau of the Census, GPO, 1973.

United States during the same period. Net out-migration during this period totalled approximately 12 per cent, which was partially offset by an excess of births vs deaths. Planning commissions having jurisdiction in the area indicate that migration is primarily a result of the lack of employment opportunities for younger people in the area which causes them to look elsewhere for jobs.

2.04312 Population in the Primary Area was approximately 52 per cent female and 99 per cent caucasion according to 1970 census figures. These percentages are comparable to statewide averages while national figures show approximately the same percentage of women (51 per cent) but a lower percentage of whites (88 per cent). The median age of the Primary Area population (34.5) is greater than that for both the state (29.1) and the nation (28.3) due primarily to the fact that almost 16 per cent of the Primary Area population is 65 years of age or older as compared to approximately 12.5 per cent for Iowa and 10 per cent for the nation. The median education (12 years) is comparable to state and national medians but the percentage of college graduates in the three county area is substantially lower than that of either Iowa or the nation.

2.04313 Residents of the Primary Area are located primarily in urban areas (61.2 per cent), which is a pattern also exhibited on state and national levels. Unlike state and national patterns, however, most of the rural residents are found in non-farm settings.

2.04314 The median family income in the three county area is $1000 to $1500 less than state or national medians. This is partially due to the high percentage of older people in the area who are living on fixed incomes. The high percentage of families below the low income level also has a negative effect on median family income.

2.04315 Available housing in the Primary Area consisted of approximately 27,000 year-round units in 1970. This represents a loss of about 1.2 per cent from the number available in 1960. Of the units available in 1970, 78 per cent were built prior to 1950, while only 10.5 per cent were constructed after 1960. It appears that available housing in the Primary Area is significantly inferior to average housing in both Iowa and the United States.

2.04316 In their 1975 Areawide Overall Economic Development Plan (OEDP), the Area XV Regional Planning Commission indicated the capacities of both water and sewer facilities for most communities throughout the three county area were more than adequate to handle present and projected loads well into the future.

2.04317 The preceeding paragraphs in this subsection describe existing conditions in the Primary Area with respect to certain sociological factors and community services. Future values for these same items will depend largely upon the degree of success with which the Area XV OEDP is implemented. If the OEDP should be 100 per cent successful, the entire profile of the area would change significantly by the year 2000. One objective of the OEDP is self-sustaining economic growth by the year 2000. In order to achieve this goal, job opportunities must be created to encourage the younger people to stay in the area. If these opportunities can be created, the median age will be lowered and the median income will increase, thereby creating additional tax revenues. These revenues can then be invested back into the community in the form of housing and other services in order to establish a more attractive environment and increase the overall standard of living. This rejuvenated community would be able to attract more people and theoretically the process would continue enabling the community to sustain growth. This highly simplified analysis of the effect of OEDP indicates the theoretical changes that should occur with the successful implementation of the plan.

2.04318 Another possibility to consider is that the OEDP will meet with little success, in which case the three county area can, at best, hope to stabilize its economic condition. If current trends were to continue, it is probable that the Primary Area would continue to experience relatively low level economic activity and sociological factors such as those discussed in prior paragraphs, would show no improvement.

2.04319 The actual degree of success which the OEDP will achieve is difficult to project but certain beneficial effects will likely accrue to the Primary Area as a result of efforts to implement the plan. The magnitude of effects on sociological factors in the three county area will depend largely on the degree of the OEDP's success.

2.0432 Ottumwa. The city of Ottumwa is located in Wapello County approximately 8 miles southwest of the Station Site and is the nearest city offering a full range of public facilities and services (Appendix G, Table G-3). The sociological character of Ottumwa is, for the most part, comparable to that of the Primary Area, as can be determined from an examination of Table 2-9. The most notable difference between Ottumwa and the Primary Area is that the level of income is higher in Ottumwa. The median family income is higher by approximately $600, while the percentage of families below the low income level is significantly lower. It should be noted, however, that state income levels are still significantly above those in Ottumwa.

2.04321 A 1972 study by the Ottumwa City Plan and Zoning Commission entitled "Comprehensive Plan For Ottumwa"[15] examined the public facilities and services of Ottumwa in light of future planning needs. The items addressed in this study include housing, water, sewer, school, recreational, health care and fire facilities.

2.04322 Housing in Ottumwa is decidedly substandard. As previously noted, approximately 76 per cent of the total year-round units in 1970 were built prior to 1950, while only 9 per cent were built in 1960 or later. A survey of 10 selected Iowa cities shows that while Ottumwa ranked third in population, it was second in the number of housing units lacking some or all plumbing facilities and tenth in the median value of owner-occupied housing and contract rent per rental unit. There were 74 homes for rent and approximately 125 for sale in mid-1974, as well as three mobile home parks, including one of the finest in the state. The housing situation has tightened recently as a new food processing plant added 200 employees to the City total, a new Hormel plant will employ approximately 500 in 1976, and expansion of existing industries is expected to add 50 to 100 jobs before year-end.

2.04323 The previously mentioned planning study for Ottumwa also indicated that new water and sewage treatment plants had recently been built. The new water and sewer facilities are rated at 12 mgd and 5 mgd respectively. These facilities were at the time of the study experiencing peak loads of 6 mgd and 4.1 mgd respectively and are considered more than adequate to handle expected needs well into the future.

2.04324 In the 1972 report it was determined that school facilities in the Ottumwa area were seriously lacking. This fact is obvious from an examination of the following tabulation.

	Elementary	Jr. High	Sr. High	Total
Fall 1971 enrollment	4,251	2,531	1,975	8,757
Fall 1971 capacity	4,325	1,625	1,400	7,350
Number of schools	13	3	1	17
Number of schools at or over capacity	6	3	1	10

Expansion of school facilities should receive a high priority in future City plans.

2.04325 Ottumwa has more than adequate land reserved for parks. National Park Service Standards recommend one acre of park land per 100 people. Ottumwa, with 30,000 people and 765 acres in park land, more than meet this standard. However, much of this park land is underdeveloped and many basic facilities are lacking. In order to meet recreational needs in future years, more efficient use and development of the park land will be required.

2.04326 Health care facilities in Ottumwa are generally of high quality, well equipped and well maintained. These facilities include 2 modern hospitals with 368 beds. Present and proposed fire facilities in Ottumwa should provide adequate protection for the community. A police force of approximately 40 officers appears to provide adequate protection to residents, as evidenced by comparison of crime rates with similar cities in Iowa.

2.0433 Other Communities. Other communities in the vicinity of OGS include Chillicothe, which is adjacent to the Station Site, and Eddyville, which is approximately 8 miles northwest. Chillicothe is a "bedroom" community with 126 residents in mid-1974 and no shopping facilities or municipal services. The town's only commercial enterprise is a small grain elevator. A county water system is currently under construction in the area. Ample space is available for mobile home parking, and a few vacant houses could possibly be renovated for rental or purchase. Due to lack of facilities and employment opportunities, Chillicothe could be expected to continue to experience low-level economic activity in the absence of OGS[10]. Eddyville is a community of 970 persons, with local shopping facilities and a normal range of small-town community services including a weekly newspaper. Eddyville is also the site of a large consolidated school district, with both elementary and high schools serving an area which includes Chillicothe and the Station Site. Available housing is very limited, but ample space is available for parking mobile homes or establishment of a mobile homes park. Local industries include a sawmill, packing house, and feed company. Limited opportunities exist for local employment.

2.044 Zoning Regulations. The OGS plant site has generally been in agricultural production with the obvious exception of roads and farm residences. The station site is presently zoned for heavy industry.

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7. "Regional Economic Information System," Bureau of Economic Analysis (BEA), Department of Commerce, October 16, 1974; Monroe, Mahaska and Wapello Counties, Iowa.

8. Personal Correspondence, Lloyd C. Stuber, Agricultural Statistician, Iowa Crop and Livestock Reporting Service, Iowa Department of Agriculture, May 16, 1975.

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11. Personal Correspondence, Phil Brunk, Iowa Southern Utilities, August 21, 1975.

12. Business Conditions Digest, Statistical Indicators Division, Series ES-1, Commerce Department, Social and Economic Statistical Administration, Economic Analysis Bureau, June 1975.

13. Personal Correspondence, Ashur Tamras, Federal Reserve Bank of Chicago, August 1, 1975.

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14. "Retail Sales and Use Tax," Research and Statistics Division, Department of Revenue, Iowa, (Quarterly Reports) 1950-74.

15 "Comprehensive Plan for Ottumwa," City Plan and Zoning Commission, Ottumwa, Iowa, 1972.

2.05 Archaeology. During May 1975, an intensive surface survey was made of the Ottumwa Station site to locate cultural evidence of past human occupations, both prehistoric and historic. The survey was conducted by a qualified archaeologist with the Environmental Research Center, Iowa City, Iowa. A total of 13 sites were located as a result of the study. The majority of the sites appeared to have minor archaeological significance.

2.051 The findings of the Environmental Research Center were forwarded to the Office of the Iowa State Archaeologist and to the Iowa State Historic Preservation Officer. It was recommended that further studies be conducted to determine the significance of the 13 prehistoric and historic sites identified.

2.052 From October through December 1975, further archaeological studies were conducted under the direction of the State Archaeologist. In addition to personnel from the Office of the State Archaeologist, members of the Southeast Chapter of the Iowa Archaeological Society assisted with the field studies. The subsoil was exposed with a roadgrader at each site previously identified. A backhoe also was used to excavate a trench in the roadgrader cut. An archaeologist then evaluated the cleared area and trench. Two additional sites were identified.

2.0521 The Iowa State Archaeologist also made a thorough search of the National Register of Historic Places and other appropriate records for the presence of historic places on or near the OGS site and none were found.

2.053 The State Archaeologists' report is included in Appendix A. It was recommended that no further archaeological work be conducted on ten sites (13WP15, 13WP16, 13WP17, 13WP18, 13WP19, 13WP21, 13WP23, 13WP25 prehistoric component, 13WP26 and 13WP27).

2.054 Additional studies were recommended on four sites; i.e., 13WP13, 13WP14, 13WP22 and 13WP25. These investigations involved primarily more clearing, exposure of subsoil, and collection and evaluation of materials from the sites. Site 13WP28 was considered significant enough to warrant preservation. This site will not be disturbed by the planned project. Additional studies on the above sites were carried out as recommended.

2.055 The State Archaeologist by letter date May 11, 1976 informed Iowa Southern Utilities Company the final phase of archaeological work was completed and that the entire area was clear for construction insofar as cultural resources were concerned. This was followed on June 29, 1976, by the State Historic Preservation Officer's letter clearing the site for construction. Copies of the letters are included in Appendix A.

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2.06 Aquatic Ecosystems

2.061 Introduction. The Des Moines River and Avery Creek are typical of midwest rivers and small streams. In-depth studies of the aquatic ecosystems in the vicinity of the proposed power generating facility have not been conducted until recently. These studies were conducted during the Summer and Fall of 1975 on the Des Moines River upstream from Chillicothe, Iowa to a point just north of the Avery Creek confluence and including Avery Creek for a distance of about 2 miles upstream from its mouth.

2.0611 Studies were extended farther upstream on the Des Moines River for benthic macroinvertebrate samples to include a sampling site near the Highway 137 bridge as it crosses the river just south of Eddyville.

2.062 Sources of Information

2.0621 Little historical information is available concerning the aquatic ecosystems or water quality of the Des Moines River and Avery Creek in the study area. Water quality studies for the entire Des Moines River have been summarized in the 1975 Water Quality Report published by the Iowa Department of Environmental Quality[1]. In general, the major water quality problems occurring in the Des Moines River appear to be physical degradation related to erosion and bacteria. Dissolved oxygen and ammonia violate Iowa stream standards at times. While dissolved oxygen problems have decreased in recent years, problems continue to exist below major municipal discharges, particularly during low flow periods. Lead, zinc, and cadmium concentrations have exceeded Iowa standards in the river below Des Moines but only lead appears to have frequently violated stream standards. The sources of these heavy metals is unknown. Concentrations of BOD appear to decrease slightly below Red Rock Reservoir. The reservoir has a cleansing effect and in addition to reducing BOD levels also removes large amounts of silt and thus reduces turbidity values downstream.

2.0622 During 1973 and 1974 a limited water sampling program was conducted by the Iowa State Hygienic Laboratory at Chillicothe, Iowa[2]. Samples were taken from the Chillicothe Bridge in June and October 1973, and February 1974. Generally, little variation was apparent during the period and water quality was relatively good. Dissolved oxygen concentrations ranged from 8.2 to 12.8 mg/l while BOD_5 values varied from 2 to 5 mg/l. Ammonia nitrogen values were relatively low (<0.01 to 0.28 mg/l) but nitrate values were high. A maximum of 5.5 mg/l NO_3 as N was observed during February.

2.0623 Studies were also conducted in the study area in conjunction with the preparation of the present environmental impact statement. Four water quality sampling points were located within the project area (Figure 2-16): 1) Chillicothe Bridge on the Des Moines River (Lower Des Moines Station); 2) Des Moines River approximately 10-15 yards above the Avery Creek junction (Upper Des Moines Station); 3) Avery Creek at its confluence with the Des Moines River (Lower Avery Creek Station); and 4) County Road Bridge as it crosses over Avery Creek within the proposed site (Upper Avery Creek Station).

2.0624 Water quality analysis from samples taken at these four stations were made on a monthly basis from June-September 1975. Data on the water quality parameters analyzed from these stations are found in Appendix B.

2.0625 With the exception of one study by Drum[3] of the diatoms of the Des Moines River, little published information is available concerning the planktonic or benthic communities of the river in the study area. Drum's studies of the lower Des Moines River, from 1961 to 1964, indicated that diatoms were the predominant planktonic form present. The species most frequently observed were: Diatom vulgare, Gomphonema divaceum, Melosira granulata, Nitzschia dissipatea, Nitzschia linearis, Nitzschia palea, Stephanodiscus hantzschii, Synedra acus and Synedra ulna.

2.0626 Studies of the plankton and periphyton communities were conducted from June-September 1975 at the four water quality sampling stations (see Section 2.0623). Phytoplankton were collected monthly, centrifuged and counted with the aid of a Sedgwick-Rafter counting cell. Zooplankton were collected twice in the summer and once in the fall by running known volumes of water through a small mesh plankton net. All zooplankton collected were classified into three familes: Copepods, Cladocerans, and Rotifers. Artificial substrates consisting of glass microscope slides were placed at the four stations in late June and removed in mid-July to determine periphytic communities. Biomass determinations and species present were determined for each station. Tabulated data for the phytoplankton, zooplankton, and periphyton studies are given in Appendix B.

2.0627 Previous fisheries studies of the Des Moines River have been conducted near Red Rock Reservoir by Mayhew and Mitzner[4,5,6] and Harrison[7] but none have specifically covered the present study area. Both reports indicate that good populations of channel catfish and rough fish such as carp, carpsucker, and buffalo fish occurred in the river from 1966 to 1968. The Mayhew and Mitzner reports of 1967 and 1968 indicated that channel catfish were the

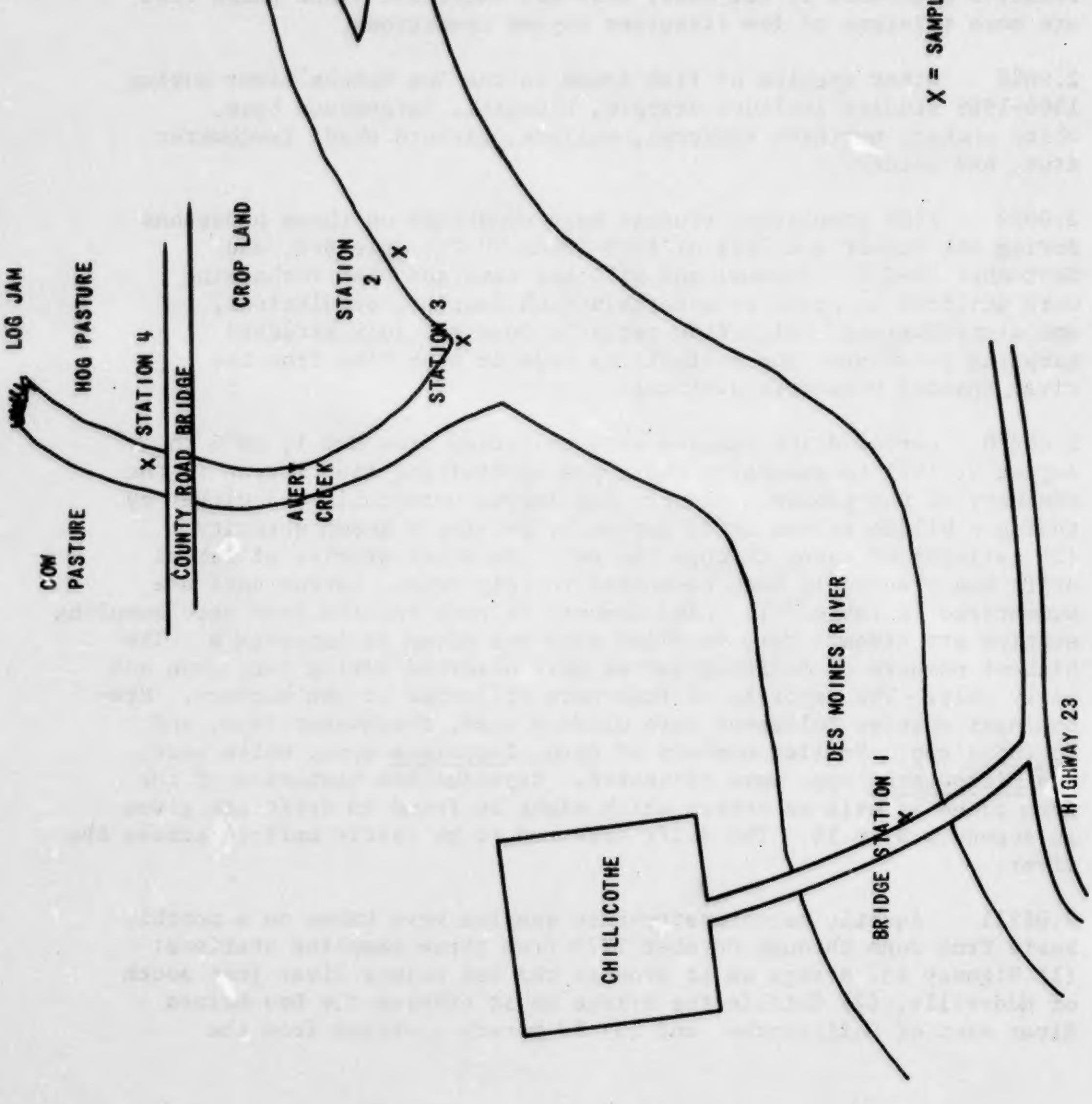

FIGURE 2-16

SAMPLING POINTS

predominant fish of the Des Moines River near Red Rock Reservoir during this study period. Their studies showed no variability in population densities of species in the area, although fish migrated up and downstream, especially during spawning periods. In January 1968, a large fish kill occurred in the Des Moines River as a result of pollution from the Des Moines Sewage Treatment Plant, which reduced dissolved oxygen concentrations to critical levels from Des Moines to Ottumwa. This kill had a significant effect on populations of channel catfish and carp, which declined markedly with populations of younger fish being most seriously affected. The relative abundance of bullhead, however, increased since these fish are more tolerant of low dissolved oxygen conditions.

2.0628 Other species of fish found in the Des Moines River during 1966-1969 studies included crappie, bluegill, largemouth bass, white sucker, northern redhorse, walleye, gizzard shad, freshwater drum, and goldeye.

2.0629 Fish population studies were conducted on three occasions during the Summer and Fall of 1975 (June 20-21, July 8-9, and September 26-27). Trammel and gill net sets and electroshocking were utilized in order to ascertain fish species, populations, and distributions. High flow rates in June and July affected sampling procedures and collections made at that time from the river channel were more difficult.

2.06210 Larval drift samples were collected from May 1, 1976 to August 9, 1976 to determine the types of drifting fish larvae in the vicinity of the proposed plant. The larvae were collected either by towing a Wildco stream drift net or by pouring a known quantity (25 gallons) of water through the net. No other studies of larval drift had previously been conducted in this area. Larvae data are summarized in Table 2-11. The numbers of each species from each sampling station are given. More detailed data are given in Appendix B. The highest numbers of drifting larvae were observed during late June and early July. The majority of fish were collected at the surface. Predominant species collected were Gizzard shad, freshwater drum, and Notropis spp. Smaller numbers of Carp, Carpoides spp., white bass, and Micropterus spp. were collected. Reproductive histories of the form found as well as others which might be found in drift are given in Appendix B, p 18. The drift appeared to be fairly uniform across the river.

2.06211 Aquatic macroinvertebrate samples were taken on a monthly basis from June through October 1975 from three sampling stations: (1) Highway 137 Bridge as it crosses the Des Moines River just south of Eddyville, (2) Chillicothe Bridge as it crosses the Des Moines River east of Chillicothe, and (3) 50 meters upstream from the

Table 2-11

SUMMARY OF LARVAE DATA

Surface						Bottom					
Sample A			Sample B			Sample A			Sample B		
Species	No.	Relative Density (per 100 M^3)	Species	No.	Relative Density (per 100 M^3)	Species	No.	Relative Density (per 100 M^3)	Species	No.	Relative Density (per 100 M^3)
			May 1, 1976					May 1, 1976			
	0	0		0	0		0	0		0	0
			May 7, 1976					May 7, 1976			
	0	0		0	0		0	0		0	0
			May 20, 1976					May 20, 1976			
Notropis	4	3	White Bass	1	0.7		0	0	Carpoides spp.	1	1
			June 5, 1976					June 5, 1976			
Gizzard Shad	1	3		0	5		0	0	Unidentified	1	1
Carpoides spp.	1			0			0				
			June 17, 1976					June 17, 1976			
Gizzard Shad	14	180	Gizzard Shad	5	270	Gizzard Shad	3	10	Gizzard Shad	4	18
Freshwater Drum	12		Freshwater Drum	2		Freshwater Drum	1		Freshwater Drum	2	
Notropis	3		Notropis	1		Unidentified	1		Carp	1	
Unidentified	1										
			July 1, 1976					July 1, 1976			
Gizzard Shad	19	60	Gizzard Shad	13	47		0	0		0	3
Freshwater Drum	3		Freshwater Drum	4							
Notropis	2										
			July 19, 1976					July 19, 1976			
Gizzard Shad	4	16	Gizzard Shad	10	24	No Sample		No Sample	No Sample		No Sample
Notropis	1		Unidentified	2							
			August 9, 1976					August 9, 1976			
Unidentified	1	1			No Sample			No Sample			No Sample

Unidentified = Due to damaged condition

County Road Bridge as it crosses over Avery Creek. The samples were collected from artifical substrate which consisted of two barbeque baskets, each containing ten concrete spheres, suspended from a float which was tethered to a bridge or some other permanent structure. All collected specimens were classified to order and finally to genera where possible. Aquatic macroinvertebrate drift samples were taken only from the Eddyville station during the same time period to determine the types of drifting organisms in the river. The drift samples were taken by placing a Wildco drift net on a support and leaving it in the river for the first hour after sundown. Bottom samples were taken from ponds in the area using a Ponar dredge which was lowered into waist-deep water. Tabulated data of the macroinvertebrate organisms are given in Appendix B.

2.063 Des Moines River

2.0631 The Des Moines River in the study area is a typical midwest river with a predominantly sand and sand-gravel bottom. A current and bottom profile study of the river conducted on July 18, 1975, indicates that the main river channel is located on the west side of the river upstream of Avery Creek to a point some 2100 feet below the confluence of Avery Creek and the river. At that point the main channel then shifts to the east bank of the river with a small channel remaining along the west bank. Average depth in the channel at the time of the study was about 9 feet with the remainder of the river averaging 3 to 4 feet. Current velocities in the river varied from 1.58 to 3.48 fps with the highest values occurring just below the water surface in the channel area. The results of current and bottom profile studies are given in Appendix B.

2.0632 The hydrological characteristics of the Des Moines River in the study area are influenced primarily by the operation of the Red Rock Dam, located near Pella, Iowa. Although a number of small tributary streams enter the river between the dam and the plant site, their total drainage area is negligible when compared with that of the river upstream of the reservoir. A list of these streams and their drainage area is given in Table 2-12.

2.0633 Discharges from the reservoir are regulated to provide flood protection for the municipalities and agricultural lands from below the dam to the confluence of the Des Moines River with the Mississippi River. If the discharges at Ottumwa reach or are predicted to reach 18,000 cfs during the growing season or 30,000 cfs during the non-growing season, or if discharges at Keosaqua reach or are predicted to reach 22,000 cfs during the growing season or 35,000 cfs during the non-growing season, the discharges from the dam are reduced accordingly. Red Rock is also operated for low

Table 2-12

PRINCIPAL TRIBUTARIES JOINING THE DES MOINES RIVER FROM RED ROCK RESERVOIR TO PLANT SITE

Name of Tributary	Point of Confluence River Mile[a]	Drainage Area square mile
English Creek	137.0	112.0
Cedar Creek	127.9	423.0
North Avery Creek	105.3	60.3
South Avery Creek	104.0	51.6

[a] Miles above the mouth of the Des Moines River where tributary enters.

Source: Conservation Storage in Red Rock and Saylorville Reservoirs; Design Memorandum No. 3, U.S. Army Engineer District, Rock Island; 13 October 1961.

flow augmentation and it is required that a minimum of 300 cfs be released from the dam to satisfy the requirements at Ottumwa. The complete operational schedule for the dam is given in Table 2-13.

2.0634 Usually, the low flow period at Ottumwa occurs from August to October while high flows occur from April through June (see Section 2.02).

2.0635 In general the water quality of the Des Moines River was found to be good during the current study and does not differ significantly from that observed in earlier studies[2,4]. The water quality in this area is affected by several factors, including the retention in the Red Rock Reservoir which, as previously mentioned, probably improves the water quality and agricultural land runoff.

2.0636 Differences between the water quality of the two stations on the Des Moines River are small. Seasonal variations are apparent. Dissolved oxygen values varied from 5.1 to 7.9 mg/l with both the minimum and maximum values being observed at Station 2 just above the Avery Creek confluence. Alkalinity concentrations in the river ranged from 142 to 203 mg/l $CaCO_3$. Nitrate concentrations varied from 0.82 mg/l N in August to 7.8 mg/l N in July. High nitrogen concentrations are not unusual in many Iowa streams. Ammonia concentrations exhibited little variation ranging from 0.01 to 0.08 mg/l N. Fecal and total coliform values were relatively low as compared to other Iowa rivers. Total coliform values ranged from 200 to 3700 organisms/100 ml. Five-day BOD values ranged from 0.8 to 3.8 mg/l, with little differences occurring between the lower and upper Des Moines stations.

2.0637 River temperatures exhibited normal seasonal variations and no evidence of upstream thermal additions were apparent. The Iowa Southern Utilities' Eddyville Generating Station, located about 7 miles upstream of the study area is a small facility with a closed cycle cooling system. The Eddyville Station is an oil-coal fueled electric generating facility with a maximum capacity of 66 MWe. The station currently serves in an auxiliary capacity operating only intermittently. Water for station operation is withdrawn from the Des Moines River by three turbine pumps, each with a maximum pumping capacity of 1000 gpm. Normal operating conditions require about 2000 gpm and during the current stand-by operation the flow is 950 gpm (each 2 cfs). The Eddyville station uses a closed cycle cooling system and there is no thermal discharge; therefore, there is no effect on the thermal regime of the river as a result of operating the facility.

Table 2-13

LAKE RED ROCK--FLOOD CONTROL REGULATION SCHEDULE

Regulation Schedule	Lake Stage		Condition	Operation
A. Normal flood control operation.	Rising	I	16 December thru 20 April.	Maintain permanent pool level 725 by releasing inflow up to 22,000 cfs, then, permit pool level to rise with uncontrolled outlet discharge until elevation 750 is reached (corresponds to uncontrolled outlet discharge of 30,000 cfs) then continue to release 30,000 cfs as pool continues to rise, except as limited by Conditions A-II, and Schedule B.
	Rising	II	16 December thru 20 April, Discharge at Ottumwa or Keosauqua above, or forecast to exceed 30,000 cfs (corresponds to stage 10.8) respectively.	Release not less than 5,000 cfs to control flow to those discharges at respective stations insofar as possible except as limited by Schedule B.
	Falling, steady or rising	III	21 April thru 15 December. Lake at or above permanent pool elevation 725.	Release 18,000 cfs until lake reaches to permanent pool level, after which it shall be held at that level insofar as possible without exceeding release of 18,000 cfs, except as limited by Condition A-IV, and Schedule B.
	Rising	IV	21 April thru December. Discharge at Ottumwa or Keosauqua above or forecast to exceed 18,000 cfs (corresponds to stage 7.5) or 22,000 cfs (corresponds to stage 7.5) respectively including release in Condition A-III.	Release not less than 5,000 cfs to control flow to those discharges at respective stations insofar as possible except as limited by Schedule B.
	Rising	V	Any date, stage at, or above, or forecast to exceed 17.0 feet on Mississippi River gage at Burlington, Iowa, or 14.0 feet on Mississippi River gage at Quincy, Illinois.	During period corresponding to time Mississippi River is above forecast stages provided lake inflow is greater than 5,000 cfs, release not less than 5,000 cfs until lake elevation 755.5 is reached; then provided (a) lake inflow is greater than 15,000 cfs until lake elevation 763.5 is reached, or, (b) if lake inflow is between 5,000 cfs and 15,000 cfs release the inflow; then, if operation (a) was followed and at elevation 763.5,

Table 2-13 (Continued)

Regulation Schedule	Lake Stage	Condition	Operation
			provided (c) lake inflow is greater than 25,000 cfs release not less than 25,000 cfs until lake elevation 775 is reached, or (d) if lake inflow is between 15,000 cfs and 25,000 cfs release the inflow; then if operation (f) was followed release not less than 30,000 cfs, except as limited by Schedule B.
B. Large magnitude flood operation	Rising	VI Any date, lake elevation is rising and above or forecast to exceed elevation 775.	When predictions indicate that anticipated runoff from a storm will appreciably exceed the storage capacity remaining in the lake when operated under Schedule A, release rates will be in accordance with the following schedule:

Pool Elev.	Outflow cfs
775	30,000
776	35,000
777	40,000
778	45,000
779	50,000
780	60,000
780.5	80,000
781	100,000
781.5	115,000
782	130,000
783	130,000
784	130,000
785	130,000
785	Open spillway tainter gates as necessary to maintain lake elevation 785 until uncontrolled spillway and outlet conduit discharge prevails, then allow lake to continue rising with uncontrolled spillway and outlet conduit discharge.

Source: U.S. Army Engineer District. Rock Island. UMRB, Des Moines River, Iowa and Minn. Master Reservoir Regulation Schedule. June 26, 1968.

2.0638 Pesticides and heavy metal concentrations were relatively low in the present study as compared to other data collected on the Des Moines River[1]. The water quality data are summarized in Table 2-14 and complete results are given in Appendix B.

2.0639 Two major types of habitat occur in the Des Moines River, the channel portion and the shoreline areas. In the channel, the river bottom in the vicinity of Chillicothe has been characterized as one of transition between upstream alluvium and downstream rock ledge[8]. Shoreline habitats are greatly influenced by the river level. At high water stages many habitats are shaded by overhanging silver maple, sandbar willows, and cottonwoods. Quiet water areas are formed where the river backs up into drainage ditches, and there are not true riffle areas or sandbars. At low water, when the river recedes from the wooded shoreline, riffle areas and sandbars occur. Rubble and brush pile areas occur at intervals along the shoreline and are doubtless important habitat for a variety of species.

2.06310 Phytoplankton populations in the Des Moines River exhibited temporal variations in number and species composition. In general, similar numbers and species were found at the lower and upper river stations, although the lower station had a greater diversity of diatom species and the upper Station 2 had more species of green algae. The diatoms Cyclotella and Nitzschia were the dominant organisms observed at both stations. Blue-green algae counts were low and consisted of Anacystis, Anabaena, and Oscillatoria. Total plankton counts ranged from 1500 to 1800 organisms/ml. These numbers are generally low as compared to other midwestern rivers. Complete phytoplankton data can be found in Appendix B.

2.06311 Copepods dominated the zooplankton community during the summer months while Cladocerans were the predominant forms in the fall. Rotifers were not abundant at either of the two river stations.

2.06312 The artifical substrates at Station 1 (lower Des Moines River) were destroyed or lost, due to the fragile nature of the substrates. However, due to the similarities in water quality at Station 1 and Station 2 on the Des Moines River, the similar velocities at the two stations, and the similar nature of bank features it is unlikely that significant differences in community structure would occur between these stations. Species composition and biomass for Station 2 are found in Appendix B. Diatoms, chiefly Melosira and Cymbella were the dominant organisms developing on the substrates.

Table 2-14

SUMMARY OF WATER QUALITY DATA
JUNE-SEPTEMBER 1975

	Station 1 Lower Des Moines River		Station 2 Upper Des Moines River		Station 3 Lower Avery Creek		Station 4 Upper Avery Creek	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
pH	7.7	8.1	7.9	8.1	7.8	8.0	6.8	7.8
DO (mg/l)	6.6	7.7	5.1	7.9	5.3	7.9	4.9	9.0
Total Alkalinity (mg $CaCO_3$/l)	142	203	144	203	139	198	68	254
NO_3 (mg N/l)	.85	7.8	.82	7.6	.8	7.0	.05	.6
NH_3 (mg N/l)	.02	.06	.01	.08	<.04	.06	.04	.5
TOC (mg C/l)	7	12	5	11	7	12	11	23
Calcium (mg $CaCO_3$/l)	160	244	144	208	144	200	212	334
Orthophosphate (mg P/l)	111	.21	.12	.15	.08	.35	.01	.16
Total Phosphate (mg P/l)	.16	.39	.14	.40	.12	.83	.09	.73
Sodium (mg Na/l)	7.5	14	8.0	17	9.2	16	2.0	20
Potassium (mg K/l)	2.3	4.8	1.8	5.0	2.9	5.4	6.0	8.6
Magnesium (mg Mg/l)	17.4	52.0	22.0	64.0	23.0	64.0	18.0	56.0
Chloride (mg Cl^-/l)	16.0	24.0	16.5	24.0	15.0	23.0	5.0	11.0
Sulfate (mg SO_4^{-2}/l)	47	116	52	116	67	118	112	220
Silica (mg SiO_2/l)	3.9	9.1	4.2	9.2	4.2	9.5	1.2	4.3
Temperature (C)	22.6	28.2	20.0	27.8	21.8	28.0	21.0	28.0
Total Dissolved Solids (mg/l)	150	460	150	460	230	550	240	560
Turbidity (JTU)	15	39	18	42	16	40	12	34
Specific Conductance	407	590	395	700	407	590	577	788
BOD_5 (mg/l)	1.0	3.8	.8	3.4	1.5	3.1	3.5	8.2
Secchi Disc (meters)	1.5	.5	.25	.25	.25	.30	.25	.25
Total Coliforms (org/100 ml)	200	2000	300	3700	600	4300	1600	4100
Fecal Coliforms (org/100 ml)	50	560	10	1300	280	2500	800	1900

Source: Institute of Hydraulic Research, University of Iowa, 1975.

2.06313 Fish population studies made during the Summer and Fall of 1975 indicate the presence of a diverse fish community in this portion of the river (Table 2-15). The fish community includes a good base of forage species including carp and carpsucker as well as a number of predator species such as walleye and northern pike. No rare or endangered species have been reported in the literature or were found in the Des Moines River during the study.

2.06314 Fish found in the greatest abundance were carpsucker and carp. All species of carpsucker had a combined relative abundance of 50.6 per cent in June, 39.7 per cent in July, and 29.7 per cent in September. Carp were found in a relative abundance of 32.9 per cent in June, 42.2 per cent in July, and 10.7 per cent in September. Fishes of the genus Notropis were found to comprise 47.3 per cent of the September collections and, because of their preference for riffle areas, were more common during the lower river levels (Table 2-16). The large number of Notropis collected was no doubt due in part to sampling techniques and locations sampled. Locations sampled were either sand bars or shallow gravel areas in both the Des Moines River and Avery Creek. Bag seines were commonly used in the riffle areas and seine samples from these areas did contain large numbers of Notropis. Pfliegler (1975) states in "The Fishes of Missouri," that many species of shiners commonly inhabit shallow areas with gravel, rock or sand bottoms and their presence in the bag seine collections was not unexpected. It is acknowledged that sampling technique plays a major role in determining the abundance of various species in collections. However, due to the nature of the habitat in the vicinity of the Ottumwa Generating Station during the 1975 summer study the large number of these organisms collected is not surprising.

2.06315 Species composition in the study area is similar to that reported for upstream sections of the Des Moines River with the exception of the number of channel catfish and carpsucker (Mayhew and Mitzner[4,5,6] and Harrison[7]). This difference may be due in part to a pollution-caused fish kill between Des Moines and Ottumwa occurring during the Winter of 1968, which resulted in an estimated loss of 54 per cent of the channel catfish population (Mayhew and Mitzner[6]). According to studies by Mayhew, changes in fish population structure were the reduction of the numerical abundance of channel catfish and carp, while bullhead and river carpsucker increased. On the other hand, the reported low number of channel catfish in the present study area may merely reflect that the sampling methods used in the present study were not effective in collecting this species.

Table 2-15
FISH SPECIES LIST

Scientific Name	Common Name
Dorosoma cepedianum (LeSueur)	Gizzard shad
Esox lucius (Linnaeus)	Northern pike
Cyprinus carpio (Linnaeus)	European carp
Carpiodes carpio (Rafinesquie)	River carpsucker
Carpoides cyprinus (LeSueur)	Quillback
Carpoides velifer (Rafinesquie)	Highfin carpsucker
Notropis Spp.	Small cyprinids
Ictiobus cyprinellus (Valenciennes)	Bigmouth buffalo
Ictiobus bubalus (Rafinesque)	Smallmouth buffalo
Moxostoma macrotepidotum (LeSueur)	Shorthead redhorse
Ictalurus punctatus (Rafinesque)	Channel catfish
Ictalurus melas (Rafinesque)*	Black bullhead
Ictalurus natalis (LeSueur)*	Yellow bullhead
Pylodictis olivaris (Rafinesque)**	Flathead catfish
Noturus flavus (Rafinesque)**	Stonecat
Monrone chrysops (Rafinesque)	White bass
Micropterus salmoides (Lacepede)*	Largemouth bass
Lepomis cyanellus (Rafinesque)*	Green sunfish
Lepomis macrochirus (Rafinesque)*	Bluegill
Pomoxis annularis (Rafinesque)*	White crappie
Pomoxis nigromaculatus*	Black crappie
Stizostedion vitreum vitreum (Mitchell)	Walleye
Aplodinotus grunniens (Rafinesque)	Freshwater drum

*Collected only in Avery Creek.

**Collected only in the Des Moines River.

All others collected in both the Des Moines River and Avery Creek.

Sources: Bailey (1970) A List of Common and Scientific Names of Fishes from the United States and Canada. American Fisheries Society Special Publication No. 6, Washington, D. C.

Eddy (1957) How to Know the Freshwater Fishes. Wm. C. Brown Company, Dubuque, Iowa.

Morris, Morris, Witt (1972) The Fishes of Nebraska. Nebraska Game and Parks Commission, Lincoln, Nebraska.

Table 2-16

RELATIVE ABUNDANCE OF FISH SPECIES SAMPLED IN THE DES MOINES RIVER IN 1975

Species	June 20-21 No.	June 20-21 Relative Abundance	July 7-8 No.	July 7-8 Relative Abundance	September 26-27 No.	September 26-27 Relative Abundance
Bigmouth Buffalo	1	1.3	3	3.6	2	0.5
Carp	26	32.9	35	42.2	45	10.7
Carpsucker, Highfin	11	13.9	2	2.4	3	0.7
Carpsucker, River	29	36.7	27	32.5	87	20.7
Carpsucker, Quillback	-	-	4	4.8	35	8.3
Channel Catfish	-	-	-	-	9	2.1
Flathead Catfish	-	-	-	-	1	0.2
Freshwater Drum	-	-	-	-	5	1.2
Gizzard Shad	-	-	-	-	15	3.6
Northern Pike	-	-	1	1.2	2	0.5
Notropis	-	-	-	-	199	47.3
Shorthead Redhorse	-	-	-	-	9	2.1
Smallmouth Buffalo	1	1.3	4	4.8	4	0.9
Stonecat	-	-	-	-	1	0.2
Walleye	-	-	-	-	4	0.9
White Bass	1	1.3	2	2.4	-	-
Total	79		83		421	

Source: Institute of Hydraulic Research, The University of Iowa, 1975.

2.06316 Larval or postlarval stages of Notropis and other Cyprinidae were collected from the Des Moines River. On July 8, 1975 two unidentified Cyprinidae were taken from the east bank and on July 18, one Notropis was collected from the west bank. High flows in the Des Moines River made larval sampling at that time difficult. Spawning and larval drift of species found in the river is probably more common in the backwaters and tributaries such as Avery Creek than in the river itself.

a. In many forms with a pellagic larval stage, such as white bass and drum, spawning frequently takes place in streams tributary to the parent stream. Other forms may spawn in various habitats. For example, crappie, perch and sunfish prefer shallow water areas with gravel bottoms and areas of vegetation, twigs and leaves, a habitat type far more common in Avery Creek than in the Des Moines River. Catfish frequently spawn in undercut banks or among piles of driftwood and logs, while carp may deposit eggs at random over rocks and logs in shallow water areas. Preceding spawning, walleye frequently move into the tributaries out of larger stream systems.

b. In addition to actual spawning activities, however, backwater areas along the Des Moines River are also essential as nursery areas for many species. During the 1975 sampling more young-of-the-year fish were collected from Avery Creek than were collected from the Des Moines River. Part of this discrepancy was partially due to the difficulty in sampling the main river with minnow and bag seines, but considering the habits of these forms it is reasonable to assume that the small creeks and backwater areas are important nursery habitats for the river.

2.06317 Macroinvertebrate population studies made during the Summer and Fall of 1975 indicated a poor-to-moderately diverse macroinvertebrate community in this portion of the Des Moines River (see Appendix B). This is apparently due to the influence of Red Rock Reservoir which prevents normal drift of upstream organisms to colonize downstream sites (Merkley[11]). The organisms which predominate below the reservoir are largely filter-feeders that feed on the particulate matter coming from the reservoir. This is documented by the occurrence of the relatively large number of hydropsychid caddisflies (Trichoptera).

2.06318 Three species of caddisflies (Trichoptera) were the predominant organisms in the Des Moines River samples. Two species of Hydropsyche and one species of Potamyia had a combined relative abundance of 88.6 per cent in June, 79.0 per cent in July, 79.7 per cent in August, and 90.8 per cent in September. The October sample was decidely more diverse with stoneflies (Plecoptera) appearing in the samples for the first time. The combined relative abundance of the specimens in October showed stoneflies (Plecoptera) with 2.3 per cent, mayflies (Ephemeroptera) with 31.7 per cent, species of Diptera with 18.2 per cent, and caddisflies (Trichoptera) at a lower level than previously with 47.7 per cent.

2.06319 There was a definite seasonal response of the fauna with respect to velocity and temperature. For example, the Simulidae (Diptera) were decidedly more abundant in the late spring and early summer when the river was flowing high, fast, and cool; these organisms gradually became less abundant until they were completely absent in the October sample. The midge larvae (Chironomidae) quickly replaced them since the midges respond more favorably to reduced velocity and warmer temperatures. This replacement pattern was also evident in some of the mayfly (Ephemeroptera) species. The two species of Baetis were better able to compete for available habitat and food when the velocity was high but were replaced by the more sluggish Stenonema when the velocity was reduced in the late summer and fall. Stoneflies (Plecoptera) appear to be more sensitive to higher temperatures than most of the other macroinvertebrates and they did not appear in the samples until October. There is no obvious reason as to why stoneflies only appeared at the station near Chillicothe and not farther upstream at Eddyville.

2.06320 Differences between the numbers and species composition of the macroinvertebrates collected at the two stations on the Des Moines River are due to the natural but variable colonization patterns of the organisms and the placement of the artificial substrate. Though site selection is carefully chosen, it is not always possible to duplicate conditions from site to site especially when considering the effects of water velocity.

2.06321 The organisms appearing in the drift samples were representative of those sampled from the artificial substrate both in numbers and composition. No rare or endangered macroinvertebrate species were found in the Des Moines River during this study.

2.06322 Pesticide levels in several species of fish collected from the Des Moines River on July 21, 1975 are given in Table 2-17. Levels were generally low as compared to levels in fish taken from other Iowa streams[9,10]. Heptachlor and degradation products of DDT were the compounds present in highest concentrations.

Table 2-17

FISH PESTICIDES RESIDUES
PARTS PER BILLION

Species	Length inches	Weight grams	Heptachlor	Heptachlor Epoxide	Aldrin	Dieldrin	p,p' DDT	p,p' DDE	p,p' DDD
Carp (Des Moines River)	15	892.9	8.2	-	-	-	-	18.8	24.2
Walleye (Des Moines River)	11	186.6	8.7	-	-	-	-	15.6	19.5
Carp (Avery Creek)	12	352.3	19.5	36.4	3.5	75.4	-	27.5	23.8
Largemouth Bass (Avery Creek)	12	463.7	36.0	32.4	-	-	21.0	24.4	10.4

Source: Institute of Hydraulic Research, The University of Iowa, 1975.

2.064 Water Bodies on the Plant Site

2.0641 There are no significant ponds on the plant site. The only significant stream flowing through the plant site is Avery Creek, although there are drainage ditches along the county road traversing the site. Avery Creek is a small stream with a drainage area of 60.3 square miles which enters the west side of the Des Moines River at River Mile 105.3. Normally the flow in the creek is low as is the average velocity. During the study velocities varied from 0.5 in June to 3.30 fps in July. Precise flow information is not available as there are no U.S. Geological Survey gaging stations located on the stream.

2.06411 The macroinvertebrate populations of Avery Creek changed dramatically during the study period of 1975. This change was accompanied by rapidly falling water levels in Avery Creek. While the creek was touching its banks and flowing downstream (primarily during the early summer), the fauna, although not as diverse or abundant as in the Des Moines River, was characteristic of a stream fauna with representatives of mayflies (Ephemeroptera), caddisflies (Trichoptera), and Diptera. But as soon as the water ceased to flow and began to stand in pools, the fauna changed to resemble the fauna in ponds of the surrounding region. For example, the midge (Chironomidae) larvae greatly increased and constituted more than 98 per cent of the total organisms when the water stopped flowing. This type of predominance by the midge larvae is characteristic of aquatic organisms in an intermittent stream when the water ceases to flow and begins to stand in pools. The presence of beetles (Coleoptera), annelids, and damselfly (Odonata) nymphs helped to characterize the pond-like nature that the creek had assumed (see Appendix B).

2.06412 Bottom samples were taken from each of the five ponds in the proposed construction site. The samples consisted of duplicate grabs using a Ponar dredge which was lowered into waist-deep water. The fauna was characteristic of ponds throughout the region and the Midwest. The composition of the organisms from the ponds showed more diversity than those found in Avery Creek, however, the number of specimens per square meter was not nearly as great. The apparent differences in species composition may be an artifact of the sampling technique as the artificial substrate sampler in Avery Creek was not especially adapted to sampling _Hexagenia_, Gyrinidae, Hemiptera species, or _Physa_ (see Appendix B). There was nothing unusual about the pond samples and no rare or endangered species were found during this study of the ponds.

2.0642 Avery Creek is bordered for the most part by woodlot stands, predominantly overhanging silver maple and pastureland. At its confluence with the river, the creek contains several log jams and brush piles. The water is quiet and the current from the river does not appear to cause appreciable swirls. Bottom type at the confluence is primarily mud. The section of the creek immediately upstream from the mouth also has a mud bottom with scattered fallen trees and log jams. At the low river levels observed during the June to September study water in this section was shallow but sufficient to maintain a connection with the river. The middle section of the creek about 500 yards above the confluence has a predominantly silt and mud bottom. This section is relatively shallow and at low river levels much of the stream bed is exposed. The upper section of Avery Creek in the vicinity of the existing County Road Bridge contains a rock-lined shore and exposed rock bottom. Habitat diversity is high during both high and low flow periods. During low flow periods isolated pools, rocks and rubble, and a few pockets of mud exist in this area. Above the County Road Bridge, the creek contains log jams and deep pockets of water which are isolated at low river levels. The bottom type in this area is predominantly silt and mud.

2.0643 The water quality of Avery Creek was found to be relatively good during the current study and was adequate to support aquatic biota which would normally occur in this stream. The primary factor affecting the water quality of Avery Creek is agricultural land runoff.

2.0644 Dissolved oxygen values varied from 4.9 mg/l to 9.0 mg/l with both maximum and minimum values occurring in the upper section of Avery Creek. In general, high dissolved oxygen values were observed in the upper portions of Avery Creek. Alkalinity values in Avery Creek ranged from 68 mg/l in September to 254 mg/l $CaCO_3$ in August. Nitrate concentrations ranged from 0.05 mg N/l to 7.0 mg N/l. In general, the values observed at the Lower Avery Creek station were higher than those obtained from Upper Avery Creek. Ammonia concentrations exhibited little variations ranging from 0.04 to 0.5 mg/l. Fecal and total coliform values were low as compared to other Iowa streams. Total coliform values ranged from 600 to 4300 organisms/100 ml while fecal coliform values ranged from 280 to 2500 organisms/100 ml. In general, coliform values found in Avery Creek were lower than those observed in the Des Moines River.

2.0645 Five-day BOD values, sulfate and potassium concentrations tended to be higher in the upper section of Avery Creek than at the mouth and these values for both stations were higher than the Des Moines River values. This is probably a direct result of agricultural runoff into the creek and the small size of the drainage basin. Water quality data is summarized in Table 2-14 and complete results are given in Appendix B.

2.0646 Phytoplankton populations in Avery Creek exhibited considerable variation in number and species composition, both temporally and between the lower and upper creek stations. Station 4, located on Upper Avery Creek, exhibited higher total counts and differed from Station 3, located at the mouth of Avery Creek, in species composition. Upper Avery Creek appears to support a wider variety of organisms, especially green algae and flagellates, whereas Lower Avery Creek supports a wider variety of diatoms and lower green algae populations. This is probably due to the greater habitat diversity at Station 4, the low velocity of the creek in this section, and the high nutrient input into the creek resulting from agricultural land runoff. Station 3 exhibited lower green algal counts, probably due to the shading effects of the woodlots along the bank. Blue-green algal counts were low at both stations and consisted of Anacystis, Oscillatoria, and Phormidium. Total plankton counts ranged from 1300 to 10,000 organisms/ml. Complete phytoplankton data can be found in Appendix B.

2.0647 Zooplankton distribution was patchy. In June Copepods were dominant at both stations while in July Copepods and Cladocerans were present in approximately equal numbers at Station 3 while Copepods dominated the zooplankton at Station 4. Rotifers were not abundant at either station.

2.0648 Analysis of the species composition of periphyton at the upper and lower stations on Avery Creek indicate significant differences between the periphytic communities at the two stations. Both species diversity and biomass values were lower at the Lower Avery Creek station than at the upstream site. These differences were probably due to the overhanging trees and resultant reduced light intensity at the station. Because of the frequent water level fluctuations in Upper Avery Creek, the periphytic community structure is probably unstable and the high productivity found in this section of the creek may not remain consistently higher than that found in the lower portions of Avery Creek.

2.0649 Avery Creek provides habitat for such activities as spawning, recruitment, and feeding of fish, especially during the higher river levels in June and July. White crappie of all age classes was collected from Avery Creek including a number of postlarval fish. Larval or postlarval walleye, gizzard shad, freshwater drum, largemouth bass, and bluegill were also collected in drift net sets. The results of the larval studies are given in Table 2-18. The creek is also a feeding area for forage fish such as carpsucker, carp, and largemouth buffalo, all of which were found in relatively large numbers (see Table 2-19). Adult fish of the predator species (northern pike, walleye, and channel catfish) were netted or electroshocked from the creek. Avery Creek appears to be utilized as a spawning and nursery area for white crappie, walleye, gizzard shad, and freshwater drum. No rare or endangered species were found during the current study in Avery Creek.

2.06410 Pesticides in several species of fish collected from Avery Creek on July 21, 1975 are given in Table 2-17. Heptachlor, heptachlor epoxide, and degradation products of DDT were the compounds present in highest concentrations.

Table 2-18

LARVAL FISH SAMPLED IN AVERY CREEK IN 1975

June 21, 1975

6	Clupidae (Gizzard Shad)
4	Cyprinidae
1	White Crappie

July 8, 1975

3	Cyprinidae
28	Freshwater Drum
1	Notropis
1	Unidentified

July 18, 1975

9	Centrarchidae
8	Notropis

July 30, 1975

11	Notropis
2	Centrarchidae

Source: Institute of Hydraulic Research, The University of Iowa, 1975.

Table 2-19

RELATIVE ABUNDANCE OF FISH SPECIES SAMPLED IN AVERY CREEK IN 1975

	June 20-21		July 7-8		September 26-27	
Species	No.	Per Cent Abundance	No.	Per Cent Abundance	No.	Per Cent Abundance
Bigmouth Buffalo	8	3	29	6.9	1	0.5
Black Bullhead	-	-	-	-	13	5.9
Bluegill	-	-	1	0.2	9	4.1
Carp	35	13.2	17	3.6	14	6.4
Carpsucker, Highfin	28	10.6	16	3.4	-	-
Carpsucker, River	105	39.8	157	29.1	37	16.8
Carpsucker, Quillback	5	1.9	2	0.4	6	2.7
Channel Catfish	1	0.4	5	1.1	2	0.9
Freshwater Drum	-	-	1	0.2	3	1.4
Gizzard Shad	15	5.7	229	48.7	85	38.6
Green Sunfish	-	-	-	-	1	0.5
Largemouth Bass	1	0.4	3	0.6	4	1.8
Northern Pike	5	1.9	6	1.3	3	1.4
Notropis	6	2.3	1	0.2	16	7.3
Shorthead Redhorse	-	-	1	0.2	-	-
Smallmouth Buffalo	3	1.1	3	0.6	-	-
Walleye	10	3.8	2	0.4	2	0.9
White Bass	4	1.5	2	0.4	3	1.4
White Crappie	34	13.0	9	1.9	21	9.5
Yellow Bullhead	1	0.4	-	-	-	-
Unidentified	3	1.1	-	-	-	-
Total	264		470		220	

Source: Institute of Hydraulic Research, The University of Iowa, 1975.

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2.07 Terrestrial Environment of the Ottumwa Generating Station Site

2.071 Introduction. The terrestrial environment of the Ottumwa Generating Site is a mosaic of agricultural fields, grasslands, and forests bordering the Des Moines River and traversed by a small stream (Avery Creek), a county highway, and the tracks of the Burlington Northern Railroad. There are no wetlands on the plant site. To describe the terrestrial aspects of the area, field visits were made from June 1975 into October 1975. Surveys of the vegetation, mammals, birds, other vertebrates, insects and other invertebrates, ecological function and successional status were made. Much of the information was obtained directly in the field, while some was gleaned from the literature.

2.072 Vegetation

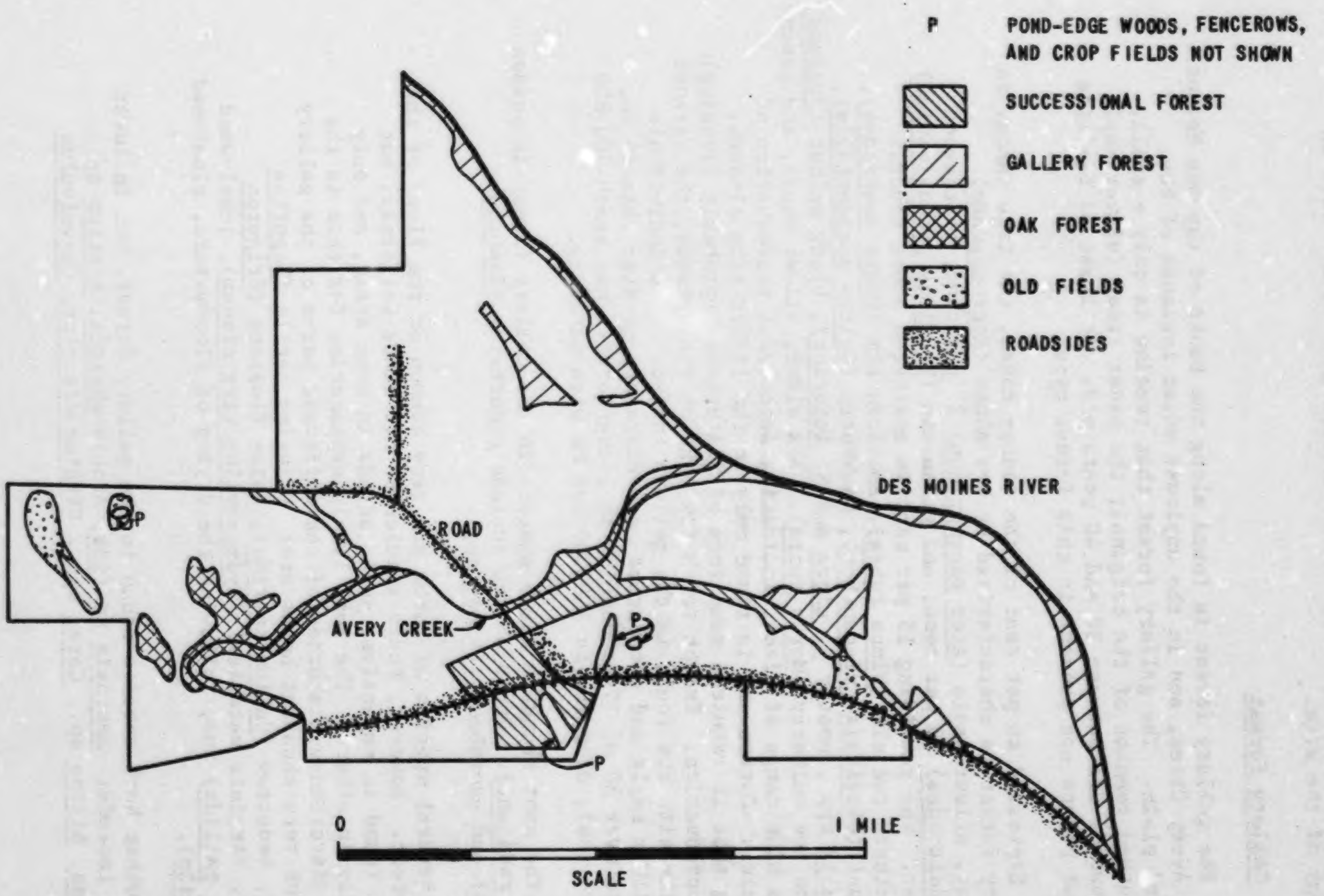
2.0721 General.

a. The two major vegetation formations represented on the Ottumwa Site (exclusive of agricultural fields and pastures) are forest and grassland. Of the forests, there are four types: 1) gallery forest along the stream-sides, 2) pond-edge woods, 3) disturbed upland forests in early succession, and 4) upland oak forest. There is no natural forest, that is, although some of the species present are also found in pristine forest. On the Ottumwa Site all the forests show sign of moderate to severe disturbance, by clearing, cutting and grazing. Figure 2-17 is a vegetation map.

b. Grasslands are represented by three types: 1) fencerows and field edges, 2) old fields, and 3) roadsides and railroad rights-of-way. As is true of forests, there are no native or natural prairies on the site. The grassland vegetation most similar to that of the presettlement condition is found along the tracks of the Burlington Northern Railroad, in one small area (about 1/2 hectare). This area has one of the common tall grasses of the prairie, Indian grass (*Sorghastrum nutans*), and some of the forbs (e.g., goldenrods, *Solidago* spp.; asters, *Aster* spp.; milkweeds, *Asclepias* spp.), but it is lacking the great diversity of species, the several tall grasses, and the functional integration of the true prairie. The original vegetation of the site has been completely altered by Man's activities, including burning, plowing, cutting, and livestock grazing.

c. The vegetation of the Ottumwa Site contains at least 51 vascular plant families. The five families with the most species are: composite or sunflower family (Compositae), grass family (Graminae), legume or bean family (Leguminosae), rose family (Rosaceae), and mustard family (Cruciferae). The species of plants show a distinctly eastern geographic relationship. In addition, a number of species are intro-

FIGURE 2-17



VEGETATION MAP OF THE OTTUMWA SITE

duced or alien, often in the same case occupying a "weedy" role in the ecology of the site.

2.0722 Gallery forest

a. The gallery forest is found along the banks of the Des Moines River and Avery Creek, and in the unplowed moist lowlands of the river flood plain. The gallery forest that remains is only a small, much disturbed remnant of the original; the older trees (silver maple and cottonwood) are between 30 and 40 years old. At least 32 families of vascular plants are present in this forest type.

b. Expressed as per cent of the canopy cover, the tree canopy in the gallery forest is characterized by box elder (*Acer negundo*) 30 per cent, silver maple (*Acer saccharinum*) 27 per cent, cottonwood (*Populus deltoides*) 18 per cent, and green ash (*Fraxinus pennsylvanica*) 10 per cent. The remaining 15 per cent is scattered among several other species: red elm (*Ulmus rubra*), American elm (*Ulmus americana*), honey locust (*Gleditsia triacanthos*), hackberry (*Celtis occidentalis*), willow (*Salix* spp., mostly *S. nigra* and *S. interior*), black walnut (*Juglans nigra*), and red mulberry (*Morus rubra*). Box elder, silver maple, and green ash show a wide range of sizes, indicating successful reproduction of these species. Cottonwood is found only in the larger size classes, indicating that it requires some form of disturbance (probably flooding) for its reproduction. Except for a few oaks on the uplands, the largest trees on the site are found in the gallery forest. Some individuals of both silver maple and cottonwood have diameters greater than 60 cm, and heights over 30 m. Tree density in young forests may reach 700-800 per hectare (ha), dropping to 400-500 per ha with maturity.

c. The most abundant shrub species in the gallery forest is poison ivy (*Rhus radicans*). Other shrubs include elderberry (*Sambucus canadensis*) and gooseberry (*Ribes* sp.).

d. Several species of herbs are very common on the floor of the gallery forest. However, these species do not occur uniformly, but rather are found in extensive, dense stands in some areas, and only occasionally in others. The most likely explanation for this is the different disturbance histories of the different parts of the gallery forest. The very abundant herbs are: stinging nettle (*Laportea canadensis*, bedstraw (*Galium aparine*), daisy fleabane (*Erigeron strigosus*), Virginia waterleaf (*Hydrophyllum virginianum*), jewel-weed (*Impatiens pallida*) and, following the drying of floodwaters, clearweed (*Pilea pumila*).

e. Other herb species found in the gallery forest, but in lower abundances include: *Ambrosia trifida*, Arabis *shortii*, *Arctium* sp., *Aster pilosa*, *Bidens* sp., *Carex* spp., *Cirsium discolor*, *Convolvulus* sp., Conyza canadensis, Dactylis glomerata, Fragaria sp., Lactuca sp., Melilotus officinale, M. alba, Menispermum canadense, Mirabilis nyctaginea, Oxalis europea, Parthenocissus vitacea, Phlox divaricata, Plantago sp., Poa pratensis, Polygonatum biflorum, Polygonum sp., Ranunculus abortivus, Scutellaria sp., Silphium perfoliatum, Smilax hispida, Taraxacum officinale, Thalictrum dioicum, Urtica dioica, Viola sp., and Vitis riparia. In addition, there are a number of species of grasses and a few forbs that are unidentifiable without complete flowers, which were unavailable at the time of collection.

2.0723 Pond-edge woods.

a. This vegetation type, on the Ottumwa Site, is found around the crescent-shaped pond (probably an old ox-bow)near the intersection of the county road and the Burlington Northern Railroad tracks. A small piece is also found at the back (south) of a small farm pond near the western end of the site. The woods are located in habitats that are very moist throughout the year. They may occasionally be under shallow water for brief periods.

b. Generally, this vegetation is younger and more dense than that of the gallery forest. The species composition of the shrub and herb layers is similar to the gallery forest, except in the pond-edge woods a large amount of snowberry (Symphoricarpus sp.) is found in the shrub component. The main difference between the gallery forest and the pond-edge woods is in the tree canopy. In the pond-edge woods, willows, especially black (Salix nigra) and sandbar (S. interior) are very common. Also, river birch (Betula nigra) is present. Other species present in relatively small amounts include American elm (Ulmus americana), black walnut (Juglans nigra), box elder (Acer negundo) red mulberry (Morus rubra), white ash (Fraxinus americana), and honey locust (Gleditsia triacanthos).

2.0724 Successional upland forest.

a. The successional upland forest is a regrowth woods found wherever the land had once been disturbed by plowing, pasture or severe cutting, and is now left alone. On the Ottumwa Site, this vegetation may be bound along the old railroad right-of-way especially where it nears Avery Creek. This type also occurs in abandoned pastures and in most of the unplowed drainage-ways that have become wooded. The growth of this forest is very dense and vigorous, characterized by young trees and a relatively high diversity of species. Twenty-five families of plants have been collected here.

b. The tree layer contains a number of species, of which four, about equally abundant, are generally the most important, occupying about

80 per cent of the canopy cover: bur oak (Quercus macrocarpa), shingle oak (Q. imbricaria), honey locust (Gleditsia triacanthos) and very large cottonwoods (Populus deltoides). Other scattered species include American elm (Ulmus americana), shagbark hickory (Carya ovata), chinkapin oak (Quercus muhlenbergii), black cherry (Prunus serotina), hackberry (Celtis occidentalis), willows (Salix interior, S. eriocephala), and black locust (Robinia pseudoacacia).

c. The shrub layer is very diverse and very dense, with no obvious dominance by any species. Found in the shrub layer are the following species: staghorn sumac (Rhus typhina), wild rose (Rosa suffolta), blackberry (Rubus sp.), dogwood (Cornus stolonifera), honeysuckle (Lonicera sp.), snowberry (Symphoricarpus sp.), poison ivy (Rhus radicans), small ashes (Fraxinus sp.), smooth sumac (Rhus glabra), small red mulberry (Morus rubra), and prickly ash (Xanthoxyllum americana).

d. The herb layer in the successional upland woods is very dense. As is true for the shrubs, no single species dominates the herb layer. Rather, the many species occur in diverse groups. Species found in the herb layer at one place or another are: Allium sp., Ambrosia artemisifolia, Amphicarpa bracteata, Anemone canadensis, Asparagus officinalis, Aster pilosa, A. nova-angliae, Botrychium virginiana, Bromus tectorum, Campanula americana, Carex sp., Cassia fasicularis, Convolvulus sepium, Conyza canadensis, Dactylis glomerata, Erigeron strigosus, Fragaria sp., Galium aparine, G. triflorum, Lactuca sp., Melilotus alba, M. officinale, Monarda fistulosa, Muhlenbergia sp., Oenothera biennis, Oxalis europea, Parthenocissus quinquefolia, Poa pratensis, Ratibida pinnata, Silphium perfoliatum, Stachys tenuifolia, Taraxacum officinale, Teucrium canadense, Trifolium pratense, T. repens, Vicia americana, Viola sp., Vitis riparia, and a number of others.

2.0725 Upland oak forest.

a. This vegetation is found in small pieces and long thin strips on the steeper slopes, and along the high slopes above Avery Creek on the western portion of the Ottumwa Site. The forest is characterized by very large oaks, spaced apart, with a dense understory and herb layer. These forests are the best forests on the site; although they would not be considered mature forests, they better approximate the undisturbed condition than any of the forests on the Ottumwa Site. Their age structure and species composition indicate that these forests have been disturbed primarily by cutting and perhaps some grazing, rather than by clearing and/or plowing. There are at least 26 plant families in this vegetation.

b. The upland oak forests are dominated by white oak (*Quercus alba*), which occupies about 50-60 per cent of the canopy cover. Other oaks sharing about 20 per cent of the cover include bur oak (*Q. macrocarpa*), red oak (*Q. rubra*), and black oak (*Q. velutina*). Other species present in small amounts and scattered individuals are: basswood (*Tilia americana*), shagbark hickory (*Carya ovata*), black cherry (*Purnus serotina*), ironwood (*Ostrya virginiana*), hackberry (*Celtis occidentalis*), river birch (*Betula nigra*) and hawthorne (*Crataegus* sp.).

c. The density of canopy trees is about 300-400 per hectare. The largest trees are white oak, which reaches almost one meter in diameter at breast height (1.5 m). The other oaks are also relatively large, ranging up to .75 m in diameter. The hickories are about 30 cm in diameter.

d. The shrub layer is very dense, and the thorn species make it very difficult to traverse. The most common shrub species are gooseberry (*Ribes missouriense*), honeysuckle (*Lonicera* sp.) and poison ivy (*Rhus radicans*). Other species in the shrub layer include: small shingle oaks (*Quercus imbricaria*), small box elders (*Acer negundo*), wild rose (*Rosa* sp.), small elms (*Ulmus* sp.), *Viburnum rafinesqueianum*, and choke cherry (*Prununs virginiana*).

e. The common herbs found in the upland oak forest are listed below. Some of these are true forest herbs, while some are species expected in more open areas, and occur in the oak forest primarily along the edges of the more open slopes above Avery Creek. The most abundant species are enchanter's nightshade (*Circaea quadrisculata*), Virginia waterleaf (*Hydrophyllum virginianum*) and Virginia creeper (*Parthenocissus vitacea*). Other common species are: *Achillea millefolium*, *Ambrosia artemisifolia*, *A. trifida*, *Amorpha canescens*, *Bromus inermis*, *Carex* spp., *Cirsium* sp., *Dactylis glomerata*, *Erigeron strigosus*, *Galium aparine*, *Impatiens* sp., *Parthenocissus quinquefolia*, *Penstamon tubaeflorum*, *Phlox divaricata*, *Poa pratensis*, *Podophyllum peltatum*, *Polygonatum biflorum*, *Potentilla simplex*, *P.* sp., *Ranunculus abortivus*, *Sanicula gregaria*, *Smilax herbacea*, *Solidago* sp., *Trifolium pratense*, *T. repens*, *Viola* sp., *Vitis riparia*, *Woodsia obtusa*, and *Xanthium* sp.

2.0726 Fencerows and field edges.

a. This vegetation type is located throughout the Ottumwa Site where fences and field edges escape cultivation, and pasture edges escape grazing. There is a dense herbaceous vegetation along these edges, but because of their relative inaccessibility, there are also scattered trees and occasional shrubs, the woody species covering perhaps 5-10 per cent of the ground surface. The scattered tree species include: black cherry (*Prunus serotina*), honey locust (*Gleditsia triacanthos*), black walnut (Juglans nigra), American elm (Ulmus americana), apple (Pyrus ioensis), hawthorn (Crataegus sp.), shingle oak (Quercus imbricaria), plum (Prunus americana) and red mulberry (Morus rubra). The scattered shrub species include: small hackberries (Celtis occidentalis), staghorn sumac (Rhus typhina), honeysuckle (Lonicera sp.), elderberry (Sambucus canadensis), poison ivy (Rhus radicans), and blackberry (Rubus sp.). At least 26 families of plants exist in this type.

b. The herbaceous edges of the fields are more-or-less zoned. Foxtails (Setaria faberi, S. lutescens and S. viridis) grow in the plowed soil, little ragweed (Ambrosia artemisifolia) is found along the immediate edge, dense stands of sweet clover (both white, Melilotus alba, and yellow, M. officinale) are found inward from the ragweed zone, and finally, in the center are found the mixed species of the fencerow proper. The most common of these latter fencerow and edge species are: smooth brome grass (Bromus inermis), orchard grass (Dactylis glomerata), bedstraw (Galium aparine), bluegrass (Poa pratensis) and wild grape (Vitis riparia). Other species include: Achillea millefolium, Ambrosia trifida, Asclepias syriaca, Barbarea vulgaris, Bidens spp., Bromus tectorum, Campanula americana, Capsella bursa-pastoris, Carex spp., Cassia fasicularis, Chenopodium album, Cirsium discolor, Convolvulus arvensis, Conyza canadensis, Daucus carota, Echinocloa sp., Elymus canadensis, Erigeron annus, E. strigosus, Hordeum jubatum, Ipomea hederacea, Lactuca sp., Leonurus cardarica, Lepidium densiflorum, Lychnis alba, Medicago sativa, Monarda fistulosa, Oxalis europea, Parthenocissus vitacea, Plantago major, Polygonum persicaria, P. sp., Potentilla recta, Ratibida pinnata, Rorippa sp., Rumex crispus, Sisymbrium officinale, Solanum carolinese, S. nigrum, Sorghastrum nutans, Stachys tenuifolia, Taraxacum officinale, Teucrium canadense, Trifolium pratense, T. repens, and several others.

2.0727 Old fields.

a. Old fields are areas that at one time had been cleared or plowed, but now are abandoned and returning to a more-or-less natural vegetation. On the Ottumwa Site, old fields are located along a swale in the westernmost section, around farm ponds, and along the Burlington Northern right-of-way where it diverges from the old railroad bed near the east end of the site. This vegetation is almost entirely composed of herbaceous species; there are a few scattered shrub-size tree species, primarily black cherry (Prunus serotina) and elms (Ulmus sp.), and a few scattered shrubs: dogwood (Cornus stolonifera), honeysuckle (Lonicera sp.) and wild rose (Rosa suffolta). Twenty-one plant families have been identified in the old fields.

b. The herbaceous component of the old field is the characteristic feature of the vegetation. Since old fields are abandoned, they usually are composed of species that in an ecological sense are early successional, and are often considered "weedy". The most common herbaceous species include smooth brome grass (Bromus inermis), wild carrot (Daucus carota), bedstraw (Galium aparine), bluegrass (Poa pratensis), goldenrods (Solidago canadensis, S. nemoralis) and wild grape (Vitis riparia).

c. Other species usually found in old fields include: Abutilon theophrastes, Ambrosia artemisifolia, A. trifida, Anthemis arvensis, Asclepias syriaca, A. verticillata, Aster pilosa, A. nova-angliae, Barbarea vulgaris, Bromus tectorum, Carex sp., Chenopodium album, Cirsium spp., Convolvulus sp., Conyza canadensis, Echinocloa spp., Elymus canadensis, Erigeron strigosus, Hordeum jubatum, Lactuca sp., Lepidium densiflorum, Melilotus alba, M. officinale, Phleum pratense, Plantago sp., Polygonum pennsylvanica, P. persicaria, Potentilla recta, Oxalis europea, Rumex sp., Sisymbrium officinale, Sorghastrum nutans, Taraxacum officinale, Trifolium pratense, T. repens, Verbena stricta, V. urticifolia, and several others.

2.0728 Roadsides and railroad rights-of-way.

a. A vegetation which has a similar species composition to that of the old-field, but which has a significantly different appearance because of strong dominance by smooth bromegrass (Bromus inermis), exists along the county road and the Burlington Northern Railroad tracks. These areas were planted to smooth bromegrass following construction activity. Since then, a number of species (at least 30 families) have invaded, including a few small trees and shrubs, but the dominant aspect is one of planted grasses. In addition to smooth bromegrass, white and yellow sweet clover (Melilotus alba, M. officinale) and red clover, (Trifolium pratense) are common in this vegetation type. The very scattered woody species include small trees (juniper, Juniperus virginiana; elm, Ulmus sp.; box elder, Acer negundo; black cherry, Prunus serotina; red mulberry, Morus rubra; bur oak, Quercus macrocarpa and scattered shrubs (elderberry, Sambucus canadensis; poison ivy, Rhus radicans; gooseberry, Ribes missouriense; dogwood, Cornus sp.; blackberry, Rubus sp.).

b. Other species of herbaceous plants found in the roadsides are also commonly found in one or more of the other vegetation types. Common roadside species include: Abutilon theophrastes, Ambrosia artemisifolia, A. trifida, Anemone canadensis, Asclepias syriaca, A. verticillata, Campanula americana, Cardaria draba, Carex spp., Cichorum intybus, Cirsium discolor, Conium maculatum, Convolvulus, sp., Dactylis glomerata, Daucus carota, Elymus canadensis, Equisetum arvense, Erigeron annus, E. strigosus, Hordeum jubatum, Lactuca sp., Medicago sativa, Oenothera biennis, Oxalis europea, Parthenocissus *vitacea*, *Pastinaca sativa*, *Phleum pratense*, *Plantago major*, *Poa pratensis*, *Rorippa islandica*, *Rumex crispus*, *Solanum carolinense*, *Taraxacum officinale*, *Trifolium procumbens*, *T. repens*, *Verbena stricta*, *V. urticifolia*, *Viola* sp., *Vitis riparia* and a number of others.

2.0729 Wet grasslands.

a. The wet grasslands of the Ottumwa Site are found as extensions of any of the main grassland vegetations into habitats where soil moisture remains high throughout the year. Often there may be standing water in the spring, or following a heavy rain. In these habitats, some of the upland species of grassland plants are not successful, whereas several additional species grow luxuriantly. Normally, the number of species growing in wet grasslands is lower than that for adjacent upland areas. Species which are particularly characteristic of wet grasslands include several species of sedges (*Carex* spp.), rushes (*Juncus* spp.), bulrushes (*Scirpus atrovirens*, *S.* sp.) and horsetail (*Equisetum* sp.).

2.073 Agriculture

2.0731 Of the Ottumwa Site, most of the acreage, is in agricultural production. During the 1975 season, approximately 301 acres were planted to corn, 147 acres to soybeans, 88 acres were in hay and 259 acres were in pasture. Farm buildings, roads, etc. account for additional acreage. The row-crop fields are annually tilled, although occasional seasons are so wet that tillage in the bottoms is impeded.

2.0732 If the amount of cropland on each soil type for the 1975 season, as determined by field visit, is multiplied by the estimated crop yields according to the U.S. Soil Conservation Service[1], the following crop values are expected: $94,080 of corn, $26,520 for soybeans, $2,640 for hay, and $2,590 for rough pasture for a total of $125,830. These estimates are based on a value of $420/acre for corn; $260/acre for soybeans; $30/acre for hay meadow; and a grazing value of $10/acre for the remaining acreage. The gross value, rounded off, of farm produce from the Ottumwa Site is about $126,000 per year. The average expected corn and bean yields are about the same as, or slighlty lower than, the average yield for the State of Iowa, given annual fluctuations.

2.074 Mammals

2.0741 **General.** The 34 species of terrestrial mammals observed or expected on the Ottumwa Site are shown in Appendix C, Table C-1. Notes were made during Summer and Fall 1975 on large game and other mammals, and standard North America census lines were run three times in the various vegetation types. In general, the mammalian fauna is not particularly diverse, and is much a reflection of the mammals of Iowa. That is, there is little that characterizes the mammals of the site that is not also characteristic of the Iowa mammals in general. Since there is a mixture of several habitats on the site, a relatively large percentage of the total mammalian fauna of Iowa is found or expected in the area. Most of the mammalian species on the site are geographically eastern, or most of the conterminous U.S.

2.0742 Game mammals. The important game mammals on the Ottumwa Site are the cottontail rabbit (*Silvilagus floridanus*), fox squirrel (*Sciurus niger*), gray squirrel (*Sciurus carolinensis*; expected), muskrat (*Ondatra zibethica*), raccoon (*Procyon lotor*), red fox (*Vulpes fulva*), mink (*Mustela vison*; expected), and white-tailed deer (*Odocoileus virginiana*). The muskrat and mink are usually trapped, while the others are usually shot. The cottontail rabbit is one of the most common animals on the site, and undoubtedly is an often-hunted mammal. Squirrels, especially the fox squirrel are also abundant, and hunter presence during Fall 1975 indicates that it is an important game species. Muskrat burrows were common along the Des Moines River banks, and probably some exist in the various ponds of the area. No trapping success is known for this species. No mink results are known as well; this species was not seen, but its presence is expected. Raccoon sign was very abundant anywhere near water, indicating an abundance of this species. Fox sign was more rarely encountered, but the habitat is very appropriate, and a relatively high population level is expected. Several deer were seen during 1975, including young, indicating that the species reproduces in the area. Residents mention that several deer are taken every year. In general, the availability of fields, forest, very abundant edge habitat, and water makes the Ottumwa Site a good game mammal area, compared with the State of Iowa as a whole.

2.0743 Other large mammals. Of the large non-game mammals, opossum (*Didelphus marsupialis*) and striped skunk (*Mephitis mephitis*) are the most common on the Ottumwa Site. Others seen include the woodchuck (*Marmota monax*) and pocket gopher (*Geomys bursarius*).

2.0744 Small mammals.

a. A number of standard North American census lines for small mammals were run in several of the major habitats on the Ottumwa Site. Several species were captured, in some cases with enough abundance to obtain good estimates of population health. Species captured are given below by habitat. No traps were set in the pond-edge woods, since this habitat is so small and scattered that sufficient trapping could not be done.

b. Gallery forest. The most abundant small mammal, by far, in the gallery forest is the white-footed mouse (Peromyscus leucopus). A total of 84 were captured, this being about 15.6 per cent of all the traps set in this habitat. Other small mammals in this habitat include the short-tailed shrew (Blarina brevicauda) of which 7 were captured, and the masked shrew (Sorex cinereus) of which only one was caught. The total catch of small mammals in this habitat was greater, both as totals and as percentages, than any other habitat investigated. About 53 per cent of all small mammals were trapped in the gallery forest.

c. Upland successional woods. The only small mammals species captured in this habitat were two species of Peromyscus, P. leucopus (white-footed mouse) and P. maniculatus (deer mouse). Population levels were not high (2.3 per 100 trap-nights), and the number of species caught was unexpectedly low.

d. Oak woods. The only small mammal species collected in the oak woods was the white-footed mouse (Peromyscus leucopus). This species was captured at a rate of 6 per 100 trap-nights, not an unusual population size for this type of habitat.

e. Fencerows and edges. Small mammals were captured at a rate of about 6 per 100 trap-nights in the fencerow and edge vegetation type. As in the other grassland types, the diversity of species was greater than in the forests, although the abundance of any one species usually is not as high as those in the forests. Six species were captured: white-footed mouse (Peromyscus leucopus), short-tailed shrew (Blarina brevicauda), masked shrew (Sorex cinereus), meadow vole (Microtus pennsylvanicus), prairie vole (M. ochrogaster) and deer mouse (Peromyscus maniculatus). At least several of each species was captured, except that only one deer mouse and one prairie vole were trapped. The first three species were captured throughout the summer and fall, but the meadow vole was only captured in the October sampling. No explanation is known for this, although this species is known to fluctuate greatly, and it may be that it is just beginning to return to the expected high density levels.

f. Old fields. Old fields also yield a number of species (four) of small mammals but with a relatively low population level. The species caught were the white-footed mouse (Peromyscus leucopus), short-tailed shrew (Blarina brevicauda), masked shrew (Sorex cinereus) and meadow vole (Microtus pennsylvanicus). Small mammals were caught at a rate of about 6 per 100 trap-nights in this habitat.

g. Roadsides. The roadside habitat has a high diversity of small mammals. Seven species were captured here, although the overall density of all species combined was not particularly high (7.4 per

100 trap-nights). Species found were white-footed mouse (Peromyscus leucopus), short-tailed shrew (Blarina brevicauda), house mouse (Mus musculus), masked shrew (Sorex cinereus), meadow jumping mouse (Zapus hudsonius), meadow vole (Microtus pennsylvanicus), and the deer mouse (Peromyscus maniculatus). The most abundant species were the white-footed mouse and the shrews.

h. Species population levels. The number of individuals of each species of small mammals captured on the Ottumwa Site are shown in Table 2-20. The total catch occurred at a rate of 8.8 per 100 trap-nights; this would be a moderate abundance level of small mammals. The greatest seasonal abundance was during August, when 14.0 small mammals were caught per 100 trap-nights, compared with 7.7 per 100 in June and 6.4 per 100 in October. Population changes in Peromyscus leucopus, the white-footed mouse, account for most of the seasonal variation. The population of the white-footed mouse appears to be healthy. There were 8 pregnant and 7 lactating females, indicating successful reproduction, as well as a range of ages. The average litter size was 4.14. The ratio of males to females in this species was 1.24; often a larger number of males is caught, presumably because of a larger home range than for the females. The population of short-tailed shrews appeared quite substantial (27 caught, 1.4 per 100 trap-nights), but the population lacks evident reproduction. Often, the levels of this species are inversely related to that of the voles (Microtus pennsylvanicus and M. ochrogaster), because the shrews prey on the voles, especially the nestlings. Since the short-tailed shrew population shows no reproduction, and the vole population shows signs of increasing (e.g., no catch during June or August, all caught in October), it may be expected that the shrew population will decrease. Three of the meadow vole females were pregnant, averaging 7.0 young per litter. Both the short-tailed shrew and the masked shrew (Sorex cinereus) had a preponderance of females in the population (sex ratio for Blarina was 0.24; for Sorex it was 0.18). One pregnant masked shrew was found. The other species did not have high enough returns in the traps for adequate estimates of population conditions.

2.075 Birds

2.0751 General. Bird species seen or suspected for the Ottumwa Site are listed in Appendix C, Table C-2. More birds were not seen primarily because field work commenced after the major spring migration was finished. There are a number of birds recorded for Iowa which are known to be accidentals or wanderers from normal ranges. These are not listed in Appendix C; Brown (1971)[2] may be consulted for these species.

2.0752 Breeding birds. A number of species of birds, other than game and raptorial birds, were seen nesting, heard singing, or noted

Table 2-20

NUMBERS AND CATCH PER 100 TRAP-NIGHTS OF SMALL MAMMALS ON THE OTTUMWA SITE, JUNE-OCTOBER 1975

Species	No. Caught	Individuals per 100 Trap-nights
White-footed mouse (*Peromyscus leucopus*)	114	5.8
Short-tailed shrew (*Blarina brevicauda*)	27	1.4
Masked shrew (*Sorex cinereus*)	15	0.8
Meadow vole (*Microtus pennsylvanicus*)	8	0.4
Deer mouse (*Peromyscus maniculatus*)	6	0.3
House mouse (*Mus musculus*)	1	0.05
Meadow jumping mouse (*Zapus hudsonius*)	1	0.05
Prairie vole (*Microtus ochrogaster*)	1	0.05
TOTAL	173	8.85

Source: Iowa State University, 1975.

in a manner that indicated a breeding population on the site. These breeding birds include: killdeer (Charadrius vociferus), mourning dove (Colaptes macrura), belted kingfisher (Magaceryle alcyon), flicker (Colaptes auratus), red-bellied woodpecker (Centurus carolinus), red-headed woodpecker (Melanerpes erythrocephalus), hairy woodpecker (Dendropus villosus), downy woodpecker (Dendrocopus pubescens), eastern kingbird (Tyrannus tyrannus), eastern phoebe (Sayornis phoebe), bank swallow (Riparia riparia), barn swallow (Hirundo rustica), purple martin (Progne subia), bluejay (Cyanocitta cristata), common crow (Corvus brachyrhynchos), black-capped chickadee (Parus atricapillus), tufted titmouse (Parus bicolor), white-breasted nuthatch (Sitta carolinensis), house wren (Troglodytes aedon), catbird (Dumetella carolinensis), brown thrasher (Toxostoma rufum), robin (Turdus migratorius), wood thrush (Hylocichla mustelina), starling (Sturna vulgaris), yellowthroat (Geothlyptis trichas), house sparrow (Passer domesticus), eastern meadowlark (Stunella magna), red-winged blackbird (Agelaius phoeniceus), Baltimore oriole (Icterus glabula), common grackle (Quiscalus quiscala), brown-headed cowbird (Molothrus ater), cardinal (Richmondena cardinalis), rose-breasted grosbeak (Pheucticus ludovicianus), indigo bunting (Passerina cyanea), dickcissel (Spiza americana), American goldfinch (Spinus tristis), rufous-sided towhee (Pipilo erythropthalmus), grasshopper sparrow (Ammodramus savannarum), chipping sparrow (Spizella passerina), field sparrow (Spizella pusilla), and song sparrow (Melospiza melodia).

2.0753 Feeding and/or roosting birds of prey. Several species of Raptors were noted feeding or roosting on the site. Roosting birds include the great-horned owl (Bubo virginianus) and the red-tailed hawk (Buteo jamaicensis). Raptors seen feeding or soaring above the site include: turkey vulture (Cathartes aura), great-horned owl, red-tailed hawk, and harrier (Circus cyaneus). Other hawks, such as the broad-winged hawk, are expected feeders on the site. Of the larger wading birds, the great blue heron (Ardea herodias) and the green heron (Butorides virescens) were seen feeding, mostly in the Des Moines River.

2.0754 Game birds. Resident upland game birds that are commonly seen include the ring-necked pheasant (Phasianus colchicus) and the bobwhite quail (Colinus virginianus). A number of migratory game birds, especially the puddle ducks (mallard, Anas platyrhychos, blue-winged teal, Anas discors, for example) and the Canada goose (Branta canadensis) are expected on the site during the migration seasons.

2.0755 Rare birds. The only rare and endangered species noted on the site was an Osprey (Pandion haliaetus) most likely migrating through along the Des Moines River. There is no evidence of breeding or roosting by this species on the site. If the bird is, in fact, migrating through, then the impact of the project will be limited to local disruption which may cause migrating ospreys to go several kilometers out of the usual route. Bald eagles (Haliaeetus leucocephalus) have been seen in the past along the Des Moines River during migration. The project impact on this species is likely to be the same as for the osprey.

2.076 Herptiles. The species of amphibians likely to occur on or near the Ottumwa Site are shown in Appendix C, Table C-3. Similarly, reptiles are shown in Appendix C, Table C-4. These tables were constructed primarily from the literature available (which is minimal)[3,4]. No attempt was made to systematically search the site for herptiles. Those seen in the course of other field work include the more common amphibians: American toad (Bufo americana), treefrog (Hyla versicolor), green frog (Rana clamitans) and bullfrog (Rana cataesbiana). Snapping turtles (Chelydra serpentina) and other turtles (unidentified) were also seen. Several garter snakes (Thamnophis sirtalis and T. radix) were observed. The project impact on this component of the fauna of the Ottumwa Site is limited to elimination of habitat, especially ponds and riparian forest, which will reduce the local populations of herptiles.

2.077 Insects and Other Invertebrates.

2.0771 Insects

a. A wide range of insect types is found on the Ottumwa Site. A comparative set of sweep samples were obtained from several different grass and edge habitats. The edge habitat showed a high diversity of species, and a high density of insects. Hayfields and fencerows show a lower abundance of both species and numbers of individuals, while the roadsides along the county highway are the poorest in insects. The edge also shows a greater abundance of insects in that fractio which is not sampled by sweep nets; both flying and crawling insects were very abundant. Some of the more common insect groups include: ants (very abundant, and very noticeable on the bait of the small mammal traps); bees and wasps, both solitary and colonial; butterflies and moths; grasshoppers and crickets; leaf hoppers; true bugs; flies; aphids; dragonflies and damselflies, and numerous scavenging and predatory beetles.

b. A number of human insect pests (non-agricultural) were noted. Field personnel can vouch for the abundance of ticks, tabanid and other biting flies, and mosquitoes.

2.0772 Spiders. Spiders are also very abundant on the Ottumwa Site. Several species of harvestmen (grand-daddy long-legs) are abundant, often seen on the small mammal traps. Other spiders include the crab spiders, jumping spiders, wolf spiders and others. All these are predators; in fact, spiders, along with predatory beetles, are likely the most abundant and most important of the predaceous fauna of the litter layer and soil.

2.0773 Other invertebrates. The most common of the macroscopic invertebrates are the following groups: earthworms (Annelida; Oligocaeta) in the soils, snails and slugs (Molluska; Gastropoda) in the litter and moist places, sowbugs (Crustacea; Isopoda) most everywhere, crayfish (Crustacea; Decapoda) near ponds and river banks, and millepedes (Diplopoda) and centipedes (Chilopoda) were common under logs, in the litter, etc.

2.078 Succession and Ecosystem Function.

2.0781 Succession.

a. The process of succession is the gradual replacement of colonizing organisms with those of longer life-spans (for the dominant species) and better competitive abilities. Normally, in the absence of fire and with enough precipitation, a plowed or cleared area will pass through several herb, grass, shrub and tree stages, ultimately reaching a relatively stable endpoint which lasts substantially longer than the earlier stages. This last stage would be a forest. In much of Iowa previous to white settlement, there were many natural fires which tended to make the successional sequence develop into complex and rich prairies rather than forest.

b. The Ottumwa Site was covered by both forest and prairie before settlement. The forests extended over the flood plain and up the more mesic slopes, while prairie covered the drier uplands. Presently, there are few traces of this original vegetation. Some of the characteristics of the present gallery forest are similar to those of the pristine forest (i.e., some species, the high abundance of nettles, etc.), and there are a few native prairie species scattered around the site, but there is no truly native vegetation (as opposed to native species).

c. The only areas for which the successional processes can be described are those which are not under cultivation, since cultivation, as long as it occurs, prevents succession. (Indeed, it can be said that the ecological purpose of cultivation is to prevent succession.) In the forested areas, the gallery forest is presently developing toward a true flood plain forest, the oak woods is developing toward a mesic deciduous forest and the secondary succession woods will become oak forests. All this assumes that these areas would be left alone, so that succession could follow normal paths. However, these areas receive great impact from the cultivated fields (e.g., nutrient runoff), are now protected from flooding which is a natural ingredient in the native environment, and, since they are in private ownership, are not protected from disturbance by cutting for the more valuable timber (e.g. black walnut, white oak, etc.). Therefore, it is unreasonable to predict that these forests will eventually evolve into anything resembling native vegetation, since the forests are not in a condition now, nor would they be in the future, under which normal succession would progress.

d. The grasslands of the site would succeed to forest in the absence of burning, or to something resembling native prairie (although, in the absence of suitable seed sources, true native prairie would be unlikely) if burning were allowed (or undertaken). These areas would eventually become shrubby, and then trees like those of the secondary successional forest, and finally oaks and mesic forest trees would dominate. However, most of the grasslands are grazed, mowed or sprayed, and these activities tend to prevent the mature grassland species and the woody plants from entering, thereby maintaining the earlier weedy stages. It is expected, then, in light of ongoing disturbance by human activities, that the processes of ecological succession on the Ottumwa Site will not work in the normal way, and that the area will continue to contain vegetation similar to that now existing.

2.0782 Ecosystem Function

a. General. There are two important aspects of ecosystem function. One is nutrient cycling, the other is productivity or energy flow. Both are difficult and time-consuming to measure; neither were quantitatively determined in the present instance. However, it is possible to make some general statements and estimates based on present environmental and biotic conditions and upon the ecological principles of energy flow and recycling.

2.0783 Nutrient cycling.

a. Nutrient cycling is the rate and amount of return of important elements, such as the common elements of agricultural fertility (nitrogen, phosphorus, and potassium) and others such as calcium, magnesium, etc. A mature and stable system normally has a high efficiency of recycling; i.e. most of the nutrients released from the biota (mostly by decomposition) are taken up and returned to living matter. A system which is leaky, that is, which tends to lose a high percentage of elements without recycling them, is considered inefficient and unstable. It is normally expected that most ecosystems, including those found in the region of the Ottumwa Site, increase the efficiency of recycling with successional development.

b. Nutrient cycling on the Ottumwa Site is estimated to be very inefficient; there is most likely a very high rate of nutrient loss from the system. This is because of the immature age of most of the vegetation, and because of the high percentage of cultivation on the site. In other words, the area is almost totally disturbed, which means that normal recycling is also totally disturbed. In addition, because of cultivation, there is a high degree of erosion from the site, causing a loss of nutrients from the soil. Fertilizers are applied to the agricultural fields, which resupply the three basic nutrients (nitrogen, phosphorus, and potassium), but this act itself creates unstable nutrient recycling, and it is also confined to only three elements, whereas vegetation requires a number of others (in lesser amounts, usually). The natural role of river flooding is to restore nutrient fertility by depositing a load of silt on the flood plain. However, when the flood plain is cultivated (and now the flooding is under human control), floods will take nutrients from the system, therefore causing a net loss. The absence of any fine litter in the gallery forests (there are large branches and trees down) indicates that the floods are removing nutrients. In the upland forests, litter accumulation is greater. In the grasslands, especially those with much smooth bromegrass (Bromus inermis), a large amount of litter accumulates, both because of slow decomposition rates in grasslands (due to aridity) and probably also spraying, which undoubtedly affects the microorganisms of decomposition. These smooth brome habitats, especially those that are sprayed, tend to be rather sterile environments for other organisms.

2.0784 Production and energy flow.

a. General. Estimating total ecological production on the Ottumwa Site is made difficult by the fact that there is precious little data for the kinds of communities found on the site, and an equal dearth of information for Iowa in general. However, by using data gathered for other areas, and by estimating differences due to climate, it is possible to make some very tentative generalizations. Primary production is defined as that amount of energy (or amount of organic matter) produced by green plants from sunlight. Secondary production is the amount of production done by animals of the higher trophic levels (herbivores, predators, etc.).

b. Agricultural. For the agricultural lands, it is possible to estimate net primary production (that which is left after respiration by the plants themselves) by converting crop yields into dry weight of organic matter, using the conversion factors of Stearns[5], and Art and Marks[6]. Using these conversions the following net primary production values are obtained (expressed as dry metric tons per hectare per year): corn 7.9, soybeans 9.6, hayfields 13.3, pasture 13.3. Multiplying by the area of each crop (from Paragraph 2.0732): corn 962 mt per year, beans 431 mt per year, hay 297 mt per year, pasture 602 mt per year. These total 2292 metric tons per year.

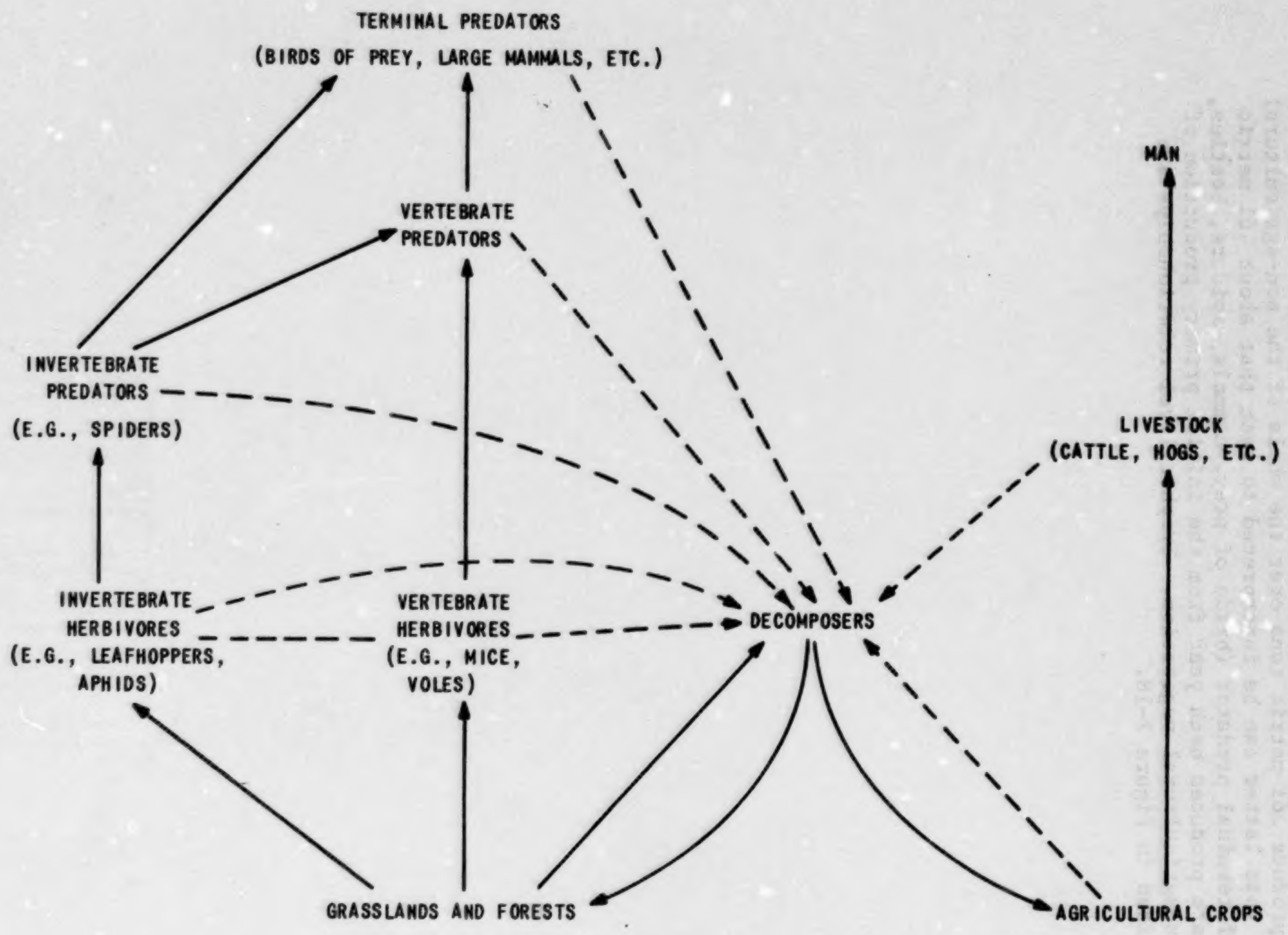
c. Grasslands. Primary production in grasslands varies with the type and with the climate. An average estimate is around 7 mt per hectare per year[7]. This would total 286 mt per year for all grasslands on the site.

d. Forests. This value is the most difficult to estimate. Reiners[8] measured oak forest production as 8.7 metric tons per hectare per year in Minnesota. Much of the Ottumwa Site forest is gallery forest and secondary succession upland woods, and these types would tend to have a higher growth rate than that of oak woods. If a value of 10 metric tons per hectare per year is used to account for this higher rate, then the forests of the site would yield about 324 metric tons per year.

e. Total net primary production. The total net primary production, which is the sum of agricultural land, grassland and forest, is an estimated 2902 metric tons per year, for the entire site. This would be an average of about 9.4 mt per hectare per year. Compared with other regions for which these kinds of estimates have been made, this average value is relatively high. It is substantially greater than figures for New York State[6], and compares favorably with North Carolina[9] and Wisconsin[5].

f. Secondary production. For the agricultural crops, there are two trophic levels; the herbivores and Man. For the rest of the site, there averages about three trophic levels above the vegetation (herbivores and two predator levels). A common figure used to describe secondary production of a trophic level is 10 per cent of the organic matter available from the next lower level. Thus, for the crops, 229 (10 per cent of 2292) metric tons of organic matter would be produced by herbivores (cattle and hogs, for example) and passed on to Man. For the other areas, the herbivores would yield about 61 metric tons, the next level would yield about 6.1 metric tons, and the fourth level would produce .61 metric tons over the whole of the non-agricultural area. This latter can be interpreted to mean that about .61 metric tons of terminal predator (birds of prey, mammals, spiders, beetles, etc.) are produced each year from the initial primary production of the non-agricultural vegetation. Trophic level relationships are summarized in Figure 2-18.

FIGURE 2-18



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2.08 Ambient Air Quality

2.081 Introduction. An assessment was made of the ambient air quality at the proposed plant site. An air sampling and meteorological station was established on the site and measurements of specific pollutants and weather parameters were made. The results of the monitoring program together with available historical data will serve as a basis for characterizing existing air quality without the Ottumwa Generating Station.

2.082 Pollutant Monitoring. A program was designed to monitor currently regulated pollutants at the proposed generating station site. Pollutants measured were suspended particulate matter, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2). The concentrations of these materials are limited by both federal and state regulations.

2.083 Meteorological Monitoring. Meteorological parameters that were determined were as follows: wind direction; wind velocity; temperature; rainfall; barometric pressure; relative humidity; and cloud cover. These climatic conditions were monitored to aid the scientists at Langston Laboratories in reporting the total suspended particulate, NO_2, and SO_2 concentrations under standard conditions (25 C and 760 mm of Hg), to facilitate the interpretation of the variations in concentration for the individual air pollutants, and to enable comparisons of the data now being generated with future ambient air quality data for the area.

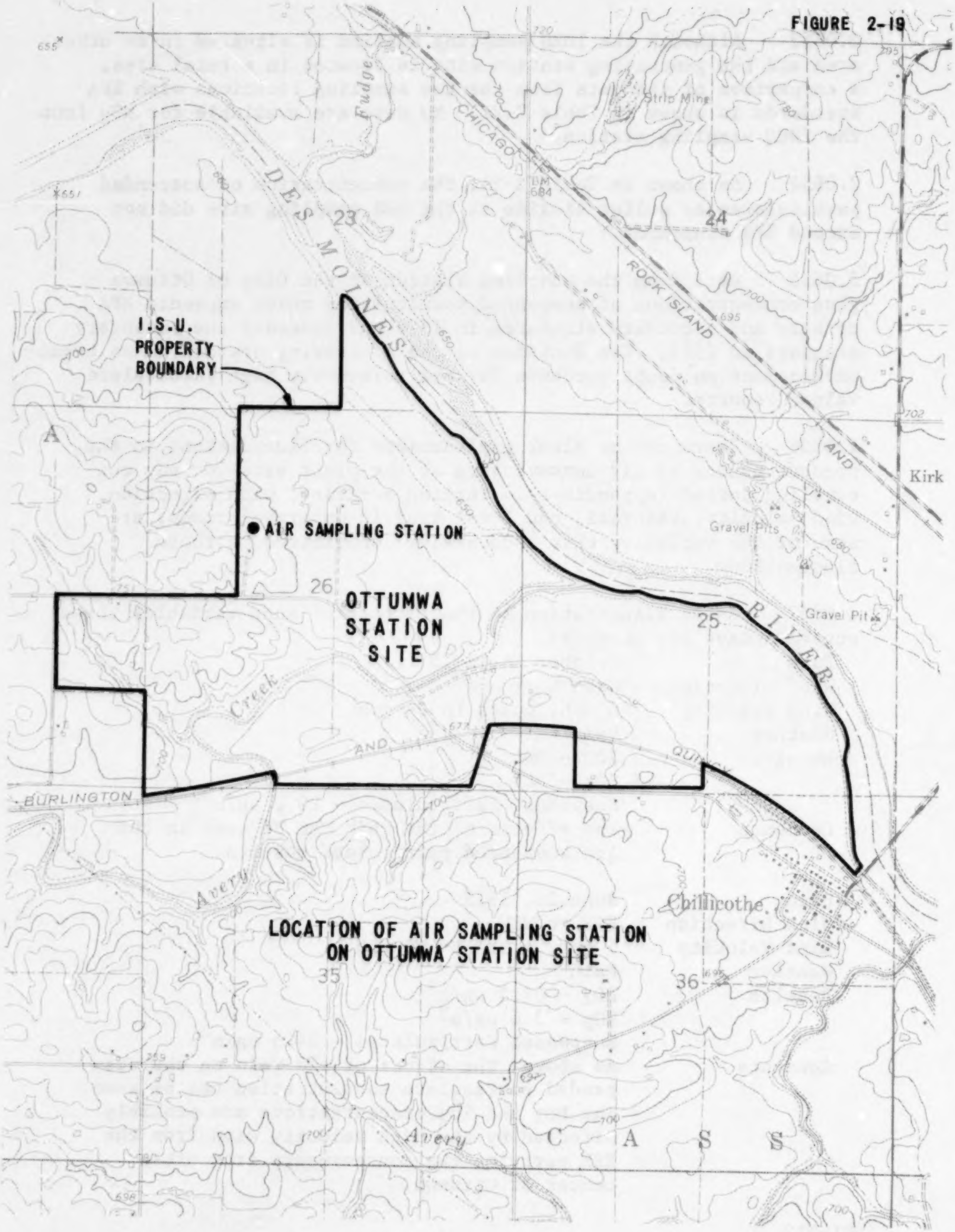
2.084 Selection of Sampling Station Site. On May 20, 1975, scientists from Langston Laboratories made a survey of the proposed plant site. A place was selected to establish an air monitoring station. In making the site selection, consideration was given to the freedom of the location from obstructions and pollution sources, availability of electricity, accessibility, security, and representativeness of the overall area. Figure 2-19 shows the location of the sampling station on the Ottumwa site.

2.085 Results. Detailed ambient air quality data from the Ottumwa site sampling station are given in Appendix D as well as the methodology employed.

2.0851 The existing ambient air quality at the proposed plant site was found to be good. During the 6-month monitoring period, the federal primary and secondary standards for suspended particulates, SO_2, and NO_2 were not exceeded on any of the sampling days.

2.0852 The nearest sampling station operated by the Iowa Department of Environmental Quality (IDEQ) is located at Ottumwa, Iowa about 8 miles southeast of the proposed generating station.

FIGURE 2-19



LOCATION OF AIR SAMPLING STATION ON OTTUMWA STATION SITE

2.0853 Although the IDEQ sampling station is situated in an urban area and the generating station site is located in a rural area, a comparison of the data from the two sampling locations with EPA standards is shown in Table 2-21. No data are available for NO_2 from the IDEQ sampling station.

2.0854 As shown in Table 2-21, the concentration of suspended particulates or sulfur dioxide at the OGS sampling site did not exceed EPA standards.

2.0855 Data from the sampling station at the City of Ottumwa give concentrations of suspended particulates which exceeded EPA primary and secondary standards in 1974 and exceeded the secondary standard in 1975. The location of the monitoring station in an urban environment no doubt accounts for the relatively high particulate values reported.

2.0856 There are no clear explanations for fluctuations in the concentrations of air contaminants at the plant site for any one sampling period (Appendix D). Farming activity, wind direction, wind velocity, rainfall, and local traffic on gravel roads, are some of the variables that undoubtedly contributed to those fluctuations.

2.0857 As an illustration of the effects of such variables three separate days are compared:

Date	October 24, 1975
Wind Direction	West
Wind Velocity	8 mph, gusts to 24 mph
Weather	Rain
Results	NO_2 - BDL SO_2 - BDL Suspended Particulates - 20.0 $\mu g/m^3$
Comments	The effects of the rain can be seen in the low suspended particulate results.

Date	June 26, 1975
Wind Direction	ESE to WSW
Wind Velocity	5 mph, gusts to 40 mph
Weather	Rain
Results	NO_2 - 67.5 $\mu g/m^3$ SO_2 - 3.6 $\mu g/m^3$ Suspended Particulates - 24.5 $\mu g/m^3$
Comments	As above, the effect of the rain on the suspended particulate concentration can be seen. The NO_2 and SO_2 concentrations are probably effected by the high velocity wind from the ESE carrying the contaminants from urban center of Ottumwa.

Table 2-21

COMPARISON OF AMBIENT AIR QUALITY DATA FROM OTTUMWA, IOWA AND THE OGS SITE WITH EPA STANDARDS

	Suspended Particulates ($\mu g/m^3$)				
	Minimum	Maximum	Geometric Mean	EPA Primary Standard	EPA Secondary Standard
IDEQ[a] 1974	19.2	313.0	79.30	260 (24-hr max.)	150
IDEQ[a] 1975	25.2	188.0	84.06		
OGS Site[b]	20.0	142.7	53.70		

	Sulfur Dioxide ($\mu g/m^3$)			
	Minimum	Maximum	Average	EPA Primary Standard[d]
IDEQ[a] 1974	BDL[c]	20.6	5.6	365 (24-hr max.)
IDEQ 1975	BDL	12.5	5.0	
OGS Site[b]	BDL	5.4	Only 3 samples greater than the minimum detectable concentration	

[a] Source: Iowa Department of Environmental Quality

[b] Source: Langston Laboratories, Inc.

[c] BDL-Below detectable limits of analytical method.

[d] No secondary standard for SO$_2$.

Date	July 2, 1975
Wind Direction	W to SSE
Wind Velocity	3 mph
Weather	No Rain (Clear)
Results	NO_2 - 15.5 $\mu g/m^3$ SO_2 - BDL Suspended Particulates - 142.7 $\mu g/m^3$
Comments	The effects of the dry conditions in the area can be seen in the high suspended particulate results. Farming activity, vacation and holiday traffic are also contributing factors to this, the highest suspended particulate result for the 6-month period.

2.0858 On sampling days that it rained, the suspended particulate concentration was reduced significantly. High velocity winds from the ESE resulted in increased SO_2 and NO_2 concentrations at the generating station site. The contaminants most likely were from the Ottumwa, Iowa area.

2.0859 Temperal trends in ambient air quality data are shown in Table 2-22. During the 6-month monitoring period, the highest concentration of NO_2 occurred in June. The only detectable amount of SO_2 also was reported in June. The highest concentration of suspended particulates was detected in July. The lowest amounts of NO_2 was found in August and November. From July through November, the concentration of SO_2 at the plant site was below the detectable limits of the analytical procedure used.

2.08510 The sampling station on the OGS site will continue operating until June 1976 to provide one year of base line ambient air quality data.

Table 2-22

TEMPERAL TRENDS IN AMBIENT AIR QUALITY, JUNE-NOVEMBER, 1975
(Ottumwa Generating Station Site)

	(µg/m^3)						
Parameter	Highest 1st	2nd	3rd	4th	5th	6th	6-Month Average
NO_2	June 27.5	July 18.8	September 2.2	October 1.7	August BDL[a]	November BDL[a]	8.4
SO_2	June 2.5	July BDL[a]	August BDL[a]	September BDL[a]	October BDL[a]	November BDL[a]	-
Suspended Particulate	July 95.7	October 73.4	November 65.8	August 59.5	June 48.1	September 32.8	62.6

[a] BDL-Below detectable limits of analytical procedure.

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III RELATIONSHIP OF PROPOSED ACTION TO LAND USE PLANS

3.01 The objective of this section is to describe current land use planning goals for the area surrounding the proposed Station Site, and to discuss the compatibility of OGS with these goals.

3.02 In attempting to ascertain the extent of land use planning efforts in the proximity of OGS, several bodies which typically produce plans in such an area were contacted. These bodies included: the City of Ottumwa (the major population center in the vicinity) and Mahaska, Monroe and Wapello Counties, all of which have political jurisdiction; and the Area XV Regional Planning Commission (XVRPC) which is only an advisory body but which has the support of all the counties in Area XV. The planning documents existing in the area range from detailed zoning ordinances to generalized area wide plans.

3.021 In 1972, the City Plan and Zoning Commission of Ottumwa published a comprehensive plan that outlined general goals which they recommended as guidelines for more specific planning policies and programs. These goals are as follows.

a. To establish a pattern of land uses that will promote the highest degree of health, safety, efficiency, and well being for all segments of the community. These patterns should develop a good working relationship between land used for residences, commercial needs, industrial development and open space.

b. To establish a circulation system for the safe and efficient movement of goods and people within Ottumwa and the Ottumwa area.

c. To provide for all the necessary uses of land and services that together make a self-sustaining and self-sufficient community.

d. To create the most desirable living areas possible focusing on residential neighborhoods together with the necessary and properly located school sites, park areas, and other amenities, free from undesirable through-traffic and from the disturbances of other land uses.

e. To preserve and promote the unique and desirable character of the City of Ottumwa and to elevate the City to its fullest potential as the major urban center of Southeastern Iowa.

f. To optimize land use potentials within the City of Ottumwa.

This plan represents the most recent planning document issued by the City.

3.022 Mahaska and Monroe Counties currently have no land use planning agencies or land use plans of their own. They do, however, provide financial support for the Area XV Regional Planning Commission and rely on the planning efforts of this agency. The status of plans published by XVRPC is discussed in a subsequent subsection.

3.023 In Wapello County, the county in which OGS is to be located, a zoning ordinance as amended through March 29, 1971, provides that except for Ottumwa and the area immediately surrounding it, most of the county is zoned agricultural. The goals of this ordinance are:

a. To promote public health, safety, morals, comfort and general welfare.

b. To conserve and protect property and property values.

c. To secure and provide the social and economic advantages resulting from an orderly planned use of land resources.

d. To facilitate adequate but economical provisions for public improvements.

3.024 The proposed OGS plant site is located in a 10 county planning district in southeast Iowa known as Area XV. The Area XV Regional Planning Commission has not published formal land use plans as of this writing but such plans are expected to be available in the summer of 1977.

3.025 In August of 1975 the XVRPC published an Areawide Overall Economic Development Plan (OEDP). Area XV has been caught in a downward economic spiral for the last several years and the OEDP is the first attempt to study the entire area in sufficient depth and with adequate detail to determine the severity of the downward spiral and the best way to counter it. The goal of the OEDP is to provide a basis for planners to analyze the situation, determine the best way out of the dilemma and implement various action programs to solve the problem. Although this report is not a land use plan, it has implications for future land use in the area through the planning goals and corresponding objectives it suggests. The planning goals and objectives which the OEDP proposes are:

a. A level of growth which would insure eventual economic growth on a self-sustaining basis. This would require reestablishment of a regional population of 200,000.
Objective: Establish a balance between resource employment and new basic manufacturing job opportunities.

b. Decentralization of future economic and population growth to insure efficient use of the region's existing infrastructure, etc. Objective: Establish one redevelopment center (Ottumwa) and three economic growth centers (Fairfield, Oskaloosa, and Centerville).

c. Coordinate development of demonstration mining and energy production projects with the Iowa Coal Project and Iowa Southern Utilities.
Objective: Provide for several demonstration projects to show how mining can contribute to industrial development and concurrently avoid environmental problems.

d. Regional improvement in the area's transportation system including: connection to Interstate Highway System, establishment of a low cost transportation system, and improvement of the rail network for shipment of farm commodities.
Objectives: (1) Promote development of Iowa Supplemental Freeway Project; (2) A regional transportation system to link isolated communities and employment centers; (3) Explore the feasibility of renovating rail lines between Northwestern and Southeastern Iowa.

e. Achieve zero unemployment rates and improve job mobility.
Objectives: (1) An effective manpower planning program;
(2) Regional education systems geared to creation of skills required for the area's growth; (3) Support for programs to insure that hard core unemployed will have potential for long-term employment;
(4) Expand opportunities for Iowa enterpriseship in the area.

f. More funds for community modernization and to meet expanded housing needs.
Objectives: Identification of sources of funding for improvements to the housing sectors and preparation of a regional housing improvement plan.

In general, these goals and objectives, if achieved, will affect future land use in the area by providing an environment conducive to growth and by establishing facilities which will help control the pattern of growth.

3.0251 The fact that the member counties of Area XV supply financial support to XVRPC is an indication of their support for the documents which the Commission produces, including the OEDP.

3.03 In order to determine the impact of OGS on land use in the area, it is necessary to examine its relationship to the known local planning attitudes as reflected in the plans previously described in this section. The construction of OGS will have a different effect on area land use than the operation of OGS, and the two phases are discussed separately.

3.031 The short-term effects of OGS on land use plans in the area are primarily construction related and consist mostly of changes necessary to accomodate construction crews and their families. Such changes might include temporary trailer parks, commercial establishments and other facilities. It should be emphasized that any impacts of this type are temporary in nature and will not permanently disrupt plans for the area (see Section 4.0120).

3.032 The long-term effects of OGS on land use in the area are related to the existence of the physical facilities of OGS and of the energy it is designed to generate.

3.033 The Station Site consists of approximately 795 acres and is located in an area previously zoned for agriculture uses according to the Wapello County zoning ordinance. This acreage has since been rezoned for heavy industrial uses.

3.034 The fact that the plant exists might lead one to expect that additional industrial growth would occur in the vicinity of the plant due to the possibility of purchasing steam from the plant or of sharing it's coal handling and storage facilities. Although it is possible that plant facilities could be modified to allow the sale of steam to a buyer, it is considered highly unlikely. Unless excess capacity is designed into the plant's boiler, steam could only be provided during off-peak hours and even then it would be an unreliable source because OGS may be called on at any moment to provide its capacity to replace that of another plant in the system which may be having problems. The coal handling and storage facilities for the plant were designed to meet the needs of OGS and as such do not allow for the possibility of sharing the facilities with outside interests.

3.035 The goals outlined in all of the previously discussed plans are strongly related to the objective of long-term, self-sustaining economic growth in the area. Many factors will influence the attainment of this objective, one of which is the availability of sufficient amounts of energy to support the hoped for increase in economic activity. The addition of OGS to the Iowa Southern Utilities system will help to meet future energy needs of the area and thus facilitate the implementation of any proposed land use plans.

IV ENVIRONMENTAL IMPACTS OF THE PROPOSED PROJECT

4.01 Environmental Impacts of Plant Construction

4.011 Terrestrial Environment

4.0111 General. The impact of the construction and operation of the Ottumwa Generating Station can be generally stated as: loss of vegetation; loss of agricultural productivity; reduction and (mostly) displacement of breeding and feeding mammals, birds and herptiles; loss of insects and invertebrates; permanent disruption of normal succession and permanent changes in ecological recycling and productivity; and changes in the aesthetic quality of the area. Were this a natural, or near-natural area, these impacts would be severe indeed, and difficult to justify. However, the impact of the plant, relative to the degree of environmental disruption already present on the site, reduces the severity of the impact of the facility. Site clearing activities have been completed and construction of the facility is scheduled to be initiated in Spring 1977.

4.0112 Impact on vegetation. There will be a loss of about 3 acres of forest and 2 acres of grassland. The loss of this vegetation will contribute little to the potential for erosion, since the acreage represents only about 0.6 per cent of the total area of the site. The best pieces of forest are the small oak woods in the southwest portion of the area, and the gallery forest. The gallery forest probably acts, to some degree, as a filter of material running off the cultivated areas into the Des Moines River.

4.0113 Impact on terrestrial vertebrates. A number of species of mammals, birds and herptiles are resident on the site, either breeding, feeding and/or resting during migration. The construction of the plant will remove the habitat for these animals, resulting in displacement into other areas and local population depression for some species. Economic studies predict that the construction and operation of OGS will not induce growth adjacent to the study area. Refer to Chapter 3 for a discussion of future growth patterns near the OGS site.

4.0114 Impact on terrestrial succession and ecosystem function. It is expected that the Ottumwa facility will permanently prevent ecological succession from occurring, and will reduce ecological productivity and affect the efficiency of nutrient recycling and conservation. Construction activities will cause minimal erosion and consequent nutrient loss. Permanent effects will depend upon what kind of vegetation cover, if any, is returned to the area. Attractive, functional vegetative cover will serve to reduce the functional impacts of the facility.

4.0115 Aesthetic impact. The most difficult of the impacts to assess is the aesthetic impact, since the severity of this depends upon subjective judgment. However, it is certain that the visual aspect of the area will be changed, and that the view of the Des Moines River valley will be degraded to some extent.

4.0116 Water quality and biological elements. There will be some runoff from the plant site during the construction which will contribute to the turbidity of the Des Moines River and Avery Creek. Construction area runoff is subject to and will comply with NPDES regulations. These effects will be temporary (during construction period), and will be similar to those resulting from runoff from plowed fields. Sloped areas on the site will be seeded where practical and vegetation established as soon as possible.

4.01161 The construction of the water intake structure will result in unavoidable contributions to the turbidity of the Des Moines River. Increased turbidity will be temporary, and the effects will be minimized by sound construction practices.

4.0117 Air quality. During the construction period, there will be some combustion gas discharges to the atmosphere as the result of operating vehicles and carrying out various activities. These discharges will not significantly affect air quality since their concentrations will not exceed ambient air quality standards. The Iowa Department of Environmental Quality has regulations limiting the amount of visible emissions from gasoline and diesel-powered vehicles (Chapter 4.4.3 (2) (d) (2) and (3).

4.01171 There will be dust associated with some construction activities. No quantitative estimates have been attempted. Dust impacts from site preparation will not be substantially different from those resulting from recurring agricultural cultivation on the site.

4.01172 Iowa regulations require that reasonable precautions be taken to prevent particulate in sufficient quantities to create a nuisance (1973 I.D.R. p. 274). To meet those requirements, sprayed water will be employed to control dust during clearing of land, grading of roads, and construction operations.

4.01173 Concerning the OGS project, there will be no open burning. All construction waste materials, rubbish, and landscape waste will be hauled away and disposed of off-site by a commercial contractor.

4.0118 Noise effects. Construction activities at the Ottumwa Station will involve a fluctuating number of men and machines over an extended period of time. Construction noise, when considered in relation to any specific off-site listener, will vary on a daily, weekly, or longer basis. As the peak of construction activity approaches, the average noise levels will increase and noise quality will change as more and different types of machinery become involved. All of these factors constitute a changing noise environment that is complex to evaluate. For simplicity, estimates of noise emission given here are instantaneous values rather than 24-hour averages.

4.01181 The Noise Control Act of 1972 (86 stat. 1234) provides for the protection of the environment and local inhabitants from certain noise emissions. The Occupational Safety and Health Administration (OSHA) has jurisdiction over the construction worker's exposure and the Environmental Protection Agency (EPA) has issued guidelines for state and local governments to use in setting standards for ambient community noise[1].

4.01182 EPA guidelines which are presently non-regulatory suggest a 24-hour exposure level of 70 dBA as the maximum level of environmental noise which will prevent any measurable hearing loss over a lifetime; a level of 55 L_{dn} as the maximum level to prevent activity interference and annoyance for certain outdoor areas where human activity takes place; and a maximum level of 45 L_{dn} as the level which will permit spoken conversation, sleeping, working, recreation, and other activities which are part of the daily human condition in indoor residential areas, hospitals, and schools. "L_{dn}" represents the "L_{eg}" with a 10 dB nighttime weighting. "L_{eg} (24)" represents the sound energy averaged over a 24-hour period. The specified levels are not event or "peak" levels for sound, but rather an average of acoustic energy over 24 hours. Occasional higher sound levels are permissible as long as a sufficient amount of relative quiet is experienced for the remaining period of time. For example, the energy contained in an 8-hour average exposure to 75 dBA is equivalent to a 24-hour average 70 dBA exposure. For practical purposes, the former exposure is equivalent to the latter only when the average level for the remaining 16 hours of the day is less than about 50 dBA.

4.01183 At a typical construction site of this size, many types and sizes of equipment will be operating and producing noise. A composite noise level of 90 dBA can be considered a conservatively reasonable noise value, produced by many varieties of diesel powered construction equipment[2]. Higher than expected estimates were used to obtain worst-case situations. No parameters other than the maximum, instantaneous sound level and the distance from the source to the receiver were considered.

4.01184 The nearest off-site house to general site construction is approximately 650 feet away. At this distance, the machinery sound attenuates to about 68 dBA outside the house. Generally, the walls of most houses will further attenuate another 20 dBA or more, so the resulting interior sound level should be less than 48 dBA with the windows closed[3]. The sound level (about 68 dBA) will be noticeable, to a person working outside, but should be acceptable as a temporary nuisance; the inside level will be somewhat louder than the existing background noise level of the average house. These are maximum expected values and should occur only when the construction machinery is operating at its closest approach to the house. No construction activities are planned to be carried out at night.

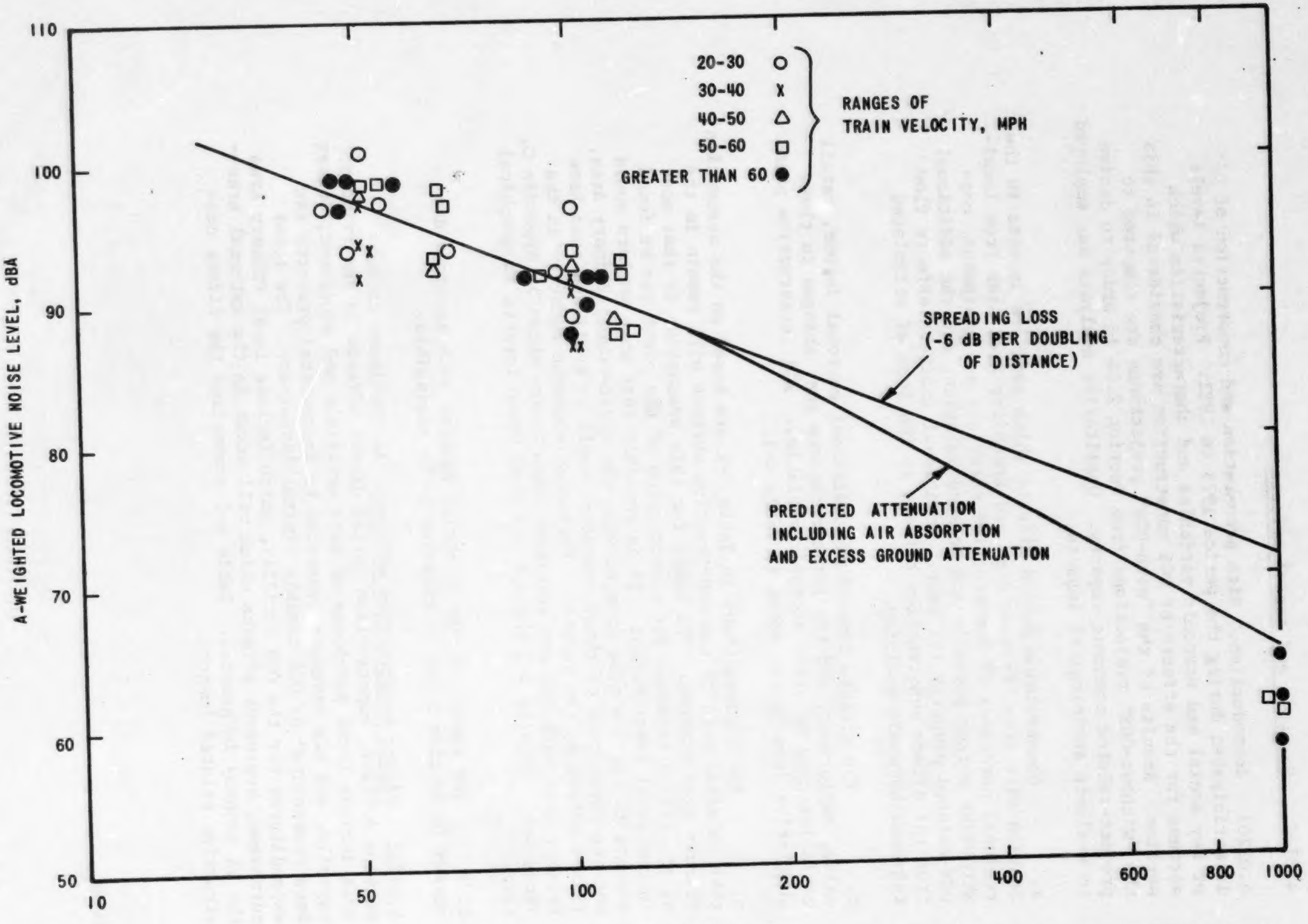
4.01185 The city of Chillicothe is adjacent to the site and the city residence nearest to one of the construction zones is approximately 1100 feet away. At this distance the construction noise level of 90 dBA will attenuate to about 63 dBA outside the residence. The walls of the house, with the windows closed, should lower this level to 43 dBA or less. Once again, these levels should be considered as maximums, occurring when construction machinery is closest to the residence.

4.01186 The existing train operation on Burlington Northern tracks located next to the OGS Site include one passenger train in both directions daily, 7 day a week, accounts for two movements per day. Freight trains number 14 per day in both directions accounts for 28 movements per day. The average train contains between 75 to 100 cars. All coal trains are 100 car lengths and move at a speed of 50 mph, all other trains travel at 60 mph.

4.01187 Once the construction of the railroad spur is complete, certain construction materials will be delivered to the site by rail. One engine and no more than about 25 cars are expected at any one time. Noise levels for a single locomotive have been measured and plotted as shown on Figure 4-1.

4.01188 The houses that would be affected most by the noise of operation of trains on the proposed rail spur presently lie closer to existing main line Burlington Northern railroad tracks than they will to the finished rail spur tracks. The noise from operation of a train on the proposed rail spur should be one-half the magnitude of the noise from the operation of the same train of the main line tracks.

4.01189 All other houses are at greater distances than the ones discussed here. Extreme cases have been chosen to reference the expected sound levels at other houses. It is anticipated that sould levels in the surrounding community will be quite tolerable in lieu of the estimated noise levels.



NOISE LEVELS FOR A SINGLE LOCOMOTION
WITH RESPECT TO DISTANCE

FIGURE 4-1

4.0120 Economic and social effects

4.01201 Introduction. Site preparation and construction of OGS is anticipated during the period 1975 to 1981. Projected levels of key social and economic variables and characteristics which account for the effects of OGS construction are considered in this section. Results of the "with-OGS" projections are compared to the "without-OGS" projections from Section 2.04 in order to derive project-related economic impacts. Qualitative analysis was employed to evaluate sociological impacts.

a. Construction period effects which generate impacts in the Station Site Area, Primary Area and Secondary Area stem from local-regional purchases of construction materials and equipment, construction worker payrolls and related salaries, and the additional OGS-related property tax base. Additional indirect effects flow from the direct construction effects in the form of stimulated regional economic activity.

b. The effects constitute additional personal income, retail sales, employment, and the further impacts that changes in these variables have on other economic variables. All construction phase cumulative impacts are shown in Table 4-1.

c. The figures shown in Table 4-1 are based on the assumption that salaries paid to the construction workers will remain in the Primary Area economy. The basis for this assumption is that most of the skills required for construction of the plant can be found in the local labor market. It is possible that some workers would commute to the job site from outside the three-county Primary Area, but the percentage of these commuters would be small and thus have little effect on the results. Projected economic activity in the Primary Area with OGS and resultant impacts are shown in Appendix G, Table G-4. Figures 4-2 through 4-4 show these impacts in graphical form.

d. The impact of OGS on social factors such as those discussed in Section 2.043 is expected to be negligible.

4.01202 Direct construction effects. As mentioned in Subsection 4.01201, construction period direct effects in the Primary Area include local purchases of site materials and equipment, worker payrolls, and tax revenues generated by incremental property tax base represented by OGS taxable capital investment. The total expenditures for the OGS facility, which include local Primary Area purchases, represent effects which will occur in the external area--the US economy in general. Table 4-2 summarizes the direct construction related impacts.

Table 4-1

PRIMARY AREA
CUMULATIVE DIRECT AND INDIRECT ECONOMIC IMPACTS
DURING OGS CONSTRUCTION (1976-1981)
1981 DOLLARS

	Impact	Percentage Increase Due to OGS Impact
Employment, Man-Years	5,144	2.69
Personal Income	$120,339,000	4.12
Wages and Salaries	103,371,000	5.84
Profit and Proprietor Income	16,967,000	1.55
Disposal Income	112,946,000	4.22
Federal Income Tax Revenues	4,771,000	2.40
State Income Tax Revenues	2,620,000	6.66
Retail Sales	23,629,000	1.63
Retail Sales Tax Revenues	861,000	2.10
Bank Deposits, $-Years	10,428,000	0.53
Farm Income	-750,000	<0.31>
Real Estate Sector (APV, REV, PSV, VRLB)	Positive Impact	*
Property Tax Revenues (Current $)		
Direct, 1976-1982	19,532,000	*
Indirect	Positive Impact	*

*Not available.

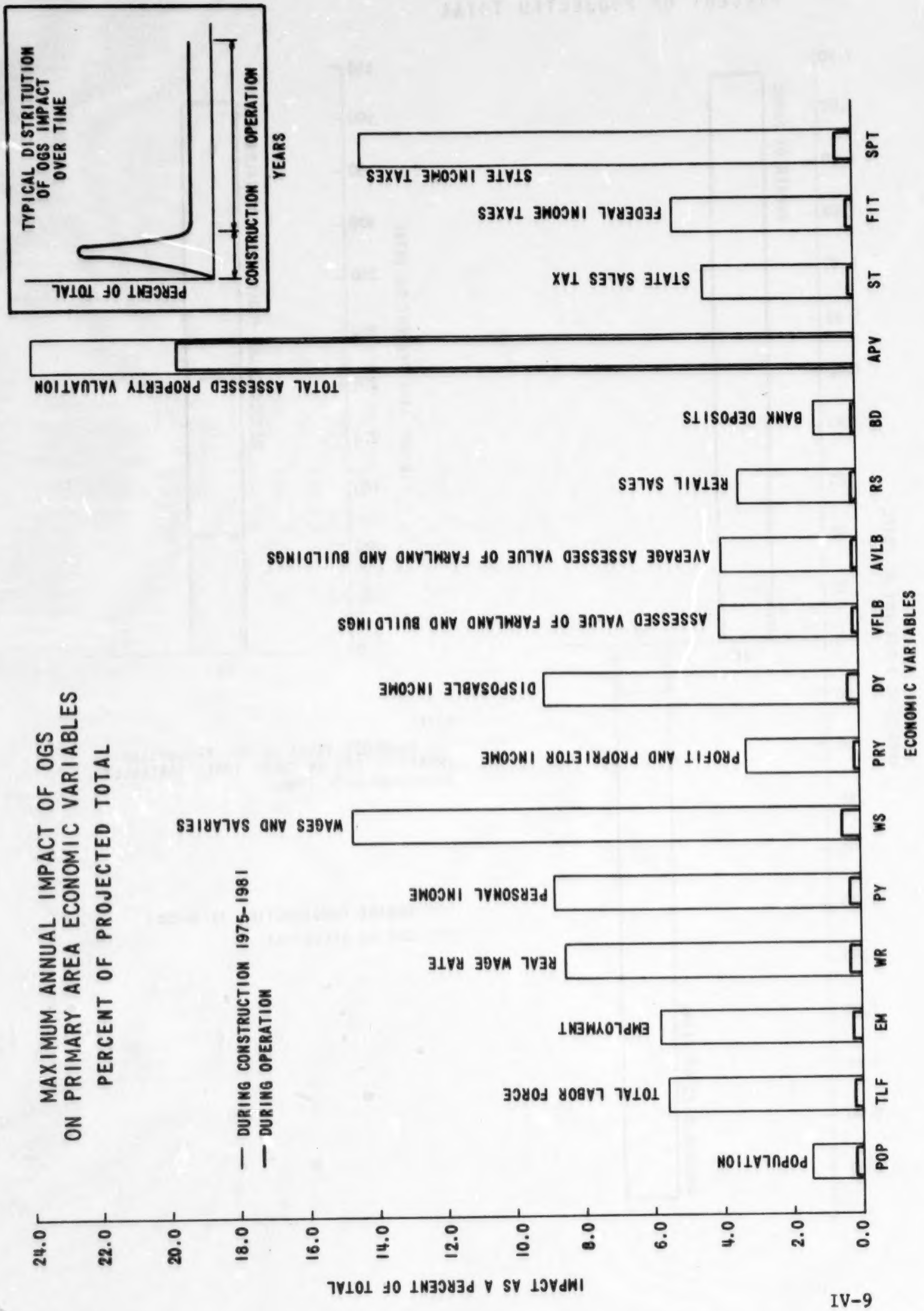
TABLE 4-2

ECONOMIC IMPACTS - CONSTRUCTION PERIOD

	Direct Construction Effects							
	1976	1977	1978	1979	1980	1981	1982	Total
Estimated Total Direct Plant & Equipment Cost, 1981 dollars	10,160,000	51,525,000	64,104,000	62,894,000	44,751,000	8,466,000	-	247,900,000
Estimated Property Taxes** current $								
Site	-	76,000	545,000	1,069,000	1,206,000	1,218,000	1,230,000	5,344,000
ISU	-	-	-	365,000	1,305,000	2,252,000	2,890,000	6,812,000
IPS	-	-	-	140,000	503,000	868,000	1,114,000	2,625,000
IA.-Ill.	-	-	-	140,000	502,000	868,000	1,113,000	2,623,000
IPALCO	-	-	-	114,000	408,000	703,000	903,000	2,128,000
Total	-	76,000	545,000	1,828,000	3,924,000	5,909,000	7,250,000	19,532,000
Estimated Employment								
Estimated new resident work force	33	80	347	457	140	*		
Average annual work force	90	241	589	921	420	*		
Estimated employment man-hours	180,000	482,000	1,178,000	1,842,000	840,000	56,000		4,578,000
Construction Payroll								
Estimates annual - $	2,539,200	6,727,500	16,442,700	25,702,500	17,588,100	*		69,000,000
Deflated annual 1981 $	3,077,300	7,844,900	18,448,700	27,748,400	18,274,000	*		78,393,300
Primary Area Expenditures								
Material & equipment - $	110,700	561,400	698,500	685,300	487,600	92,200		2,635,700
Deflated material & equipment - 1981 $	134,200	654,700	783,700	739,800	506,600	92,200		2,911,200

*Negligible.

**Five year construction budget was used to determine additions to be used for property taxes (State of Iowa formula also used; property taxes lag construction period by one year.)

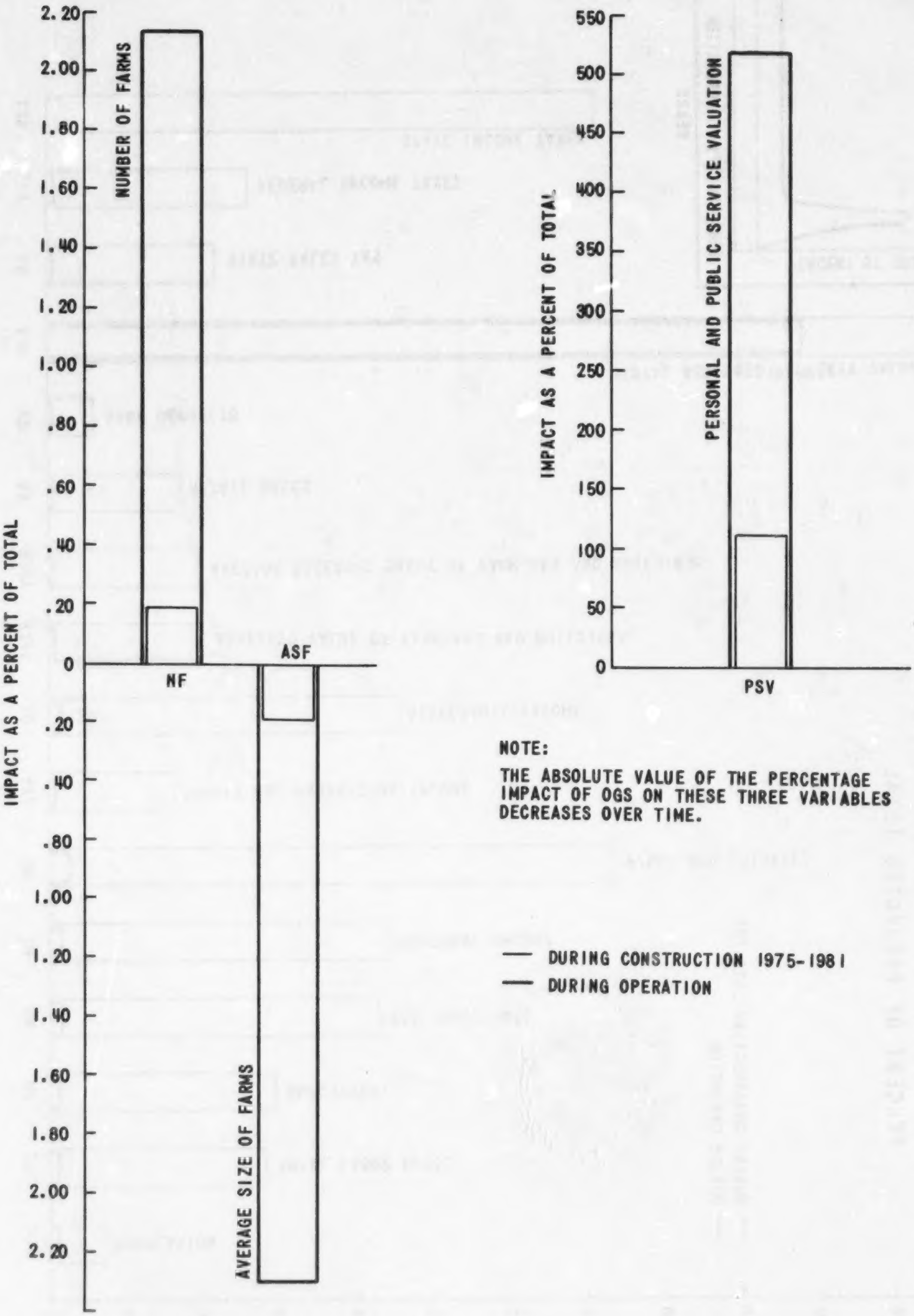


MAXIMUM ANNUAL IMPACT OF OGS ON PRIMARY AREA ECONOMIC VARIABLES

PERCENT OF PROJECTED TOTAL

FIGURE 4-3

ON PRIMARY AREA ECONOMIC VARIABLES
PERCENT OF PROJECTED TOTAL

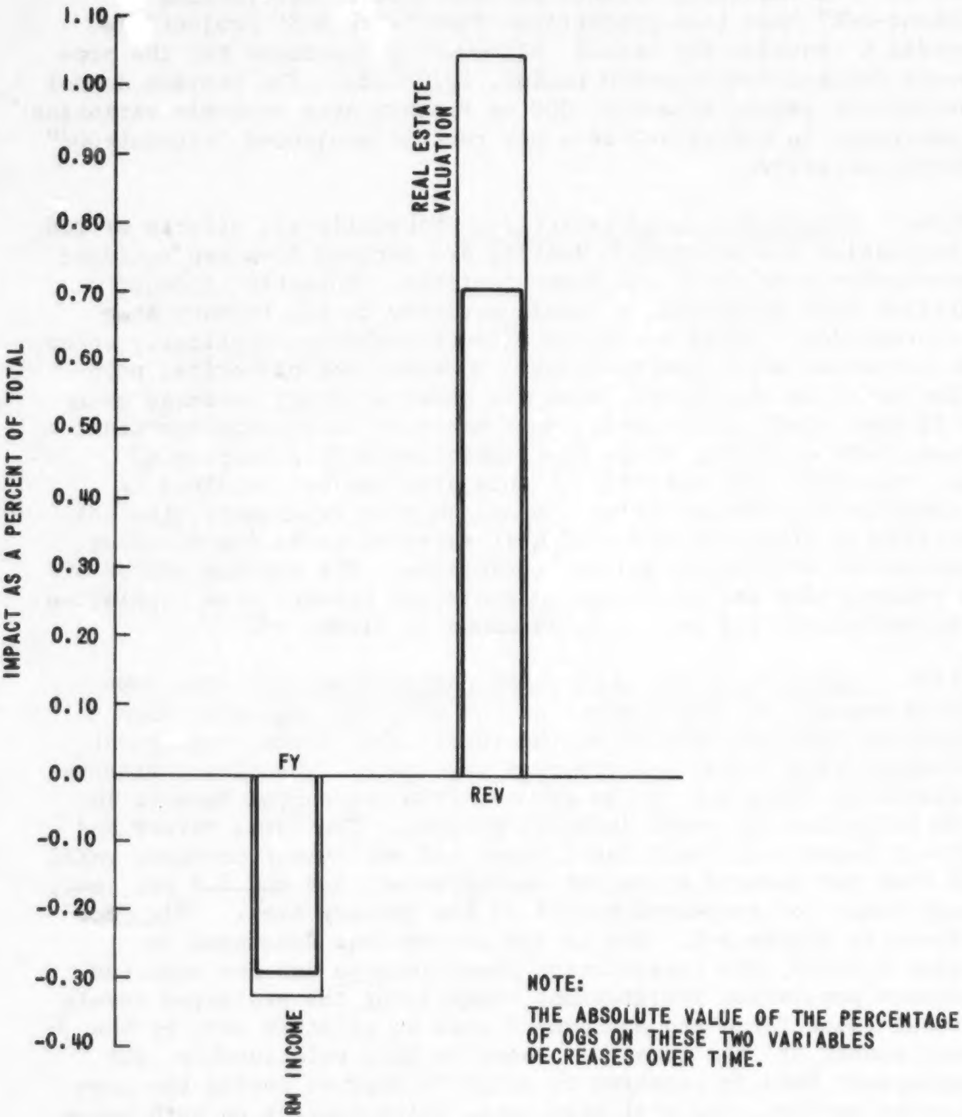


NOTE:
THE ABSOLUTE VALUE OF THE PERCENTAGE IMPACT OF OGS ON THESE THREE VARIABLES DECREASES OVER TIME.

FIGURE 4-4

MAXIMUM ANNUAL IMPACT OF OGS ON PRIMARY AREA ECONOMIC VARIABLES

PERCENT OF PROJECTED TOTAL



NOTE:
THE ABSOLUTE VALUE OF THE PERCENTAGE OF OGS ON THESE TWO VARIABLES DECREASES OVER TIME.

4.01203 Indirect construction effects. Direct project expenditures and effects discussed in Section 4.01202 will produce further changes in the Primary Area and other areas by stimulating economic activity. "With-OGS" projections of Primary Area economic activity are derived from the econometric model. The exogenous and other key economic variables are stimulated by direct construction expenditures and the resulting effects are measured by subtracting "without-OGS" base line projections from "with-OGS" projections. Appendix G contains the actual "with-OGS" projections for the previously defined construction period, 1976-1981. The maximum annual construction period impact of OGS on Primary Area economic variables is expressed in Figure 4-2 as a per cent of projected "without-OGS" economic activity.

4.01204 Population characteristics. Virtually all effects of OGS on population and population density are derived from new resident construction work force and their families. Potential induced migration from stimulated economic activity in the Primary Area is disregarded. These migration effects would hypothetically occur from increased work opportunities. However, the historical population trend in the Primary Area has shown a slight decrease over the 25-year study period while most monetary indicators (personal income, bank deposits, etc.) have exhibited stable increases. Thus, increased real activity in this area has not resulted in discernible population inflow. Based on this experience, the sole quantifiable effect on population is expected to be new resident construction work force and their families. The maximum effect of OGS construction and operation on projected Primary Area population is approximately 1.5 per cent, as shown in Figure 4-2.

4.01205 Labor force and employment characteristics. The OGS-related impacts on this segment of the economy consist of both direct and indirect effects on the total labor force, employment, the unemployment rate, and the real wage rate. The direct effects displayed in Table 4-2 can be removed from the annual impacts in order to derive the total indirect effects. The total direct and indirect impacts on total labor force and employment increase until 1979 when the impacts represent approximately 5.6 and 5.8 per cent, respectively, of projected totals in the Primary Area. This fact is shown in Figure 4-2. Due to the assumptions discussed in Section 4.01203, the construction phase impacts are not expected to induce population immigration. Therefore, the projected levels of total labor force and employment will be affected only by the actual number of jobs created. Based on this relationship, the unemployment rate is expected to slightly improve during the construction period. The real wage rate, which depends on both wages and salaries and employment, is expected to show a maximum annual increase of 8.5 per cent during construction, as seen in Figure 4-2.

4.01206 Income levels. The effects discussed in this section concern personal income and its components; wages and salaries, profit and proprietor income, and farm income. Each year's "with-OGS" projections take into account the multiplier effects resulting from OGS worker payrolls and purchases of construction materials and equipment in the Primary Area. As workers spend their incomes on goods and services they indirectly generate further income for employees and owners of local business. Local purchases of construction materials and equipment produce similar effects by stimulating retail sales, profit and proprietor income, wages and salaries, personal income and disposal income.

a. Construction phase impacts on personal income, wages and salaries, profit and proprietor income, and disposable income increase until they attain their expected maximum effect in 1979. Additional personal income in the Primary Area is expected to amount to almost 9 per cent of the base line level, as shown in Figure 4-2. Wages and salaries and profit and proprietor income reach respective levels of 14.6 per cent and 3.2 per cent above the base line in 1979, the peak construction phase impact year. Disposable income is projected to increase in approximately the same proportion as personal income. The indirect effects on wages and salaries are expected to amount to about 25 per cent of the total impact over the construction period.

b. The effect of OGS construction on farm income in the area is expected to be less than 0.4 per cent of total projected farm income. Projected maximum annual impact of OGS on farm income is shown in Figure 4-2.

4.01207 Agricultural land use. Projected OGS impacts on number of farms, average size of farms, and value and average value of farmland and buildings are shown in Figure 4-3. Land in farms is not charted because the impact is less than 0.1 per cent. Although all other agricultural indicators are charted, the only substantial effect on this sector is the expected temporary effect on assessed value of farmland and buildings. The projected impacts shown in Figure 4-3 are better interpreted as the probable positive direction of change, rather than the actual magnitude of effects upon assessed valuation of real and personal property.

4.01208 Industrial and business activity. By 1979, OGS-related expenditures are expected to stimulate retail sales by 3.4 per cent. This is the year of maximum projected impact on retail sales. Bank deposits are stimulated by OGS-related economic activity as shown in Figure 4-2. Bank deposits are projected to increase by a maximum of 1.1 per cent in 1979.

4.01209 Real estate sector. Virtually no indirect effects due to OGS are expected to occur in this sector. There are no projected indirect impacts on total assessed property valuation, real estate valuation, and real estate valuation per square mile and only an insignificant impact on personal and public service valuation.

4.01210 Government revenues. Retail sales taxes and federal and state income tax revenues in the Primary Area are all expected to increase during construction. Again, 1979 is the year of maximum expected impact when additional retail sales tax will constitute approximately 4.3 per cent of "without-OGS" levels. Federal and state income tax revenues are expected to increase to a maximum in 1979 of 5.2 and 14.3 per cent, respectively. These annual effects quickly return to near preconstruction levels as do most other impacts measured by the Primary Area model.

4.01211 Community profile/public facilities and services. The community profile, as portrayed in Section 2.043 is not expected to vary significantly due to the construction or operation of OGS. Population age, migration and education will remain virtually unchanged due to the small number of OGS workers relative to the population already in the area. Other demographic factors discussed in Section 2.043 are also not expected to exhibit significant variation.

a. Construction period impacts on public facilities and services will take the form of temporary requirements for housing, school facilities, and community services such as churches and indoor and outdoor recreational facilities. The magnitude of these impacts will be primarily determined by where the construction workers migrating to the study area will locate. The manner in which these new resident workers and their families are likely to locate, assuming they will locate within a reasonable commuting distance, can be estimated by employing a gravity model as found in both the physical and social sciences. This model expresses the relatively greater attractiveness of larger towns than small towns, and of towns closer to the site than those at greater commuting distances. It also indicates that a small town close to the site may be as attractive as a larger town more distant from the site. When this type of analysis is employed, using the peak construction year work force of 457 in 1979 (Table 4-2), it appears that the majority of the construction workers and their families will locate in Ottumwa, Chillicothe, or Oskaloosa. The percentage increase in population will be significant only in Chillicothe. As previously stated in paragraph 2.0433, Chillicothe is a "bedroom community" offering few services to its residents. As a result of this lack of public facilities and services, and allowing for the proximity of the City of Ottumwa, it seems reasonable to assume that the residents of Chillicothe have, and will, continue to depend on Ottumwa for the services and facilities which their community does not provide. In light of this assumption, the expected additional residents in Chillicothe will have a negligible impact on the available facilities and services.

b. As previously discussed, some of the facilities and services in the areas surrounding the proposed Station Site are presently inadequate while others enjoy excess capacity. For those facilities which are already lacking, the impact of OGS will be negligible because the addition of a relatively few people will not significantly affect the quality of service in the area. Those facilities which have excess capacity also will not be appreciably affected by the presence of OGS in the area. Construction period impacts will take the form of temporary requirements for housing, school facilities, and community services such as churches and recreational facilities. Operation period impacts will be permanent in nature but of a smaller magnitude than those experienced during the construction period.

4.02 Environmental Impacts of Generating Station Operation

4.021 Air Quality Control Standards. To describe the effects of combustion emissions, it is important to describe the applicable air quality standards for the project site.

4.0211 There are two general types of regulations applicable to the discharge of air pollutants. *Emission standards* limit the rate of air pollutant discharge from the plant. *Ambient air quality standards* limit the resulting air pollutant concentration that may occur at ground level. Federal and Iowa emission standards and ambient air quality standards are discussed for particulate matter and oxides of both sulfur and nitrogen.

4.0212 Federal standards applicable to the plant are promulgated by the U.S. Environmental Protection Agency (EPA): Iowa standards, by the Iowa Department of Environmental Quality.

4.0213 Emission standards are expressed as limits on the number of pounds per unit of heat input, generally as pounds per million Btu of heat input (lb/MBtu). Emission standards are also established as limitations on the visibility of emissions. Visibility limits are expressed as the permissible per cent opacity of a discharge or sometimes as Ringelmann numbers which correspond approximately to 20 per cent increments in opacity.

4.0214 Ambient air quality standards are generally expressed as pollutant concentrations; i.e. an amount per unit of volume. Micrograms per cubic meter ($\mu g/m^3$) or parts per million (ppm) are used to express pollutant concentrations in air.

4.0215 Federal emission standards are applicable to particulate matter, sulfur dioxide, and nitrogen dioxide. The federal standards are summarized in Table 4-3.

TABLE 4-3

FEDERAL EMISSION STANDARDS

Air Pollutant	Maximum Emission Rate lb/MBtu	Estimated Maximum Ottumwa Generating Station Emission Rate lb/MBtu
Sulfur Dioxide	1.2	1.2
Particulate Matter[a]	0.10	0.10
Nitrogen Dioxide	0.70	0.70

[a] The opacity of emissions shall not exceed 20 per cent.

4.0216 Iowa emission standards applicable to particulate matter, sulfur dioxide, and nitrogen dioxide are the same as the federal standards.

4.0217 The Ottumwa Plant is situated within the Southeast Iowa Intrastate Air Quality Control Region (AQCR) established by the EPA.

4.0218 The federal ambient air quality standards are summarized in Table 4-4. Iowa has adopted the federal ambient air quality standards.

TABLE 4-4

FEDERAL AMBIENT AIR QUALITY STANDARDS AND
ESTIMATED CONCENTRATION OF POLLUTANTS FROM OPERATION
OF OTTUMWA STATION

Air Pollutant	3-Hour Average[a] µg/m^3(ppm)	24-Hour Average[a] µg/m^3(ppm)	Annual Average[b] µg/m^3(ppm)
Sulfur Dioxide			
Primary Standard	--	365(0.14)	80(0.03)
Secondary Standard	1300(0.50)	--	--
Estimated Ottumwa Generating Station	72(0.027)	24(0.009)	1.4(0.0005)
Suspended Particulates		µg/m^3	µg/m^3
Primary Standard	--	260	75
Secondary Standard	--	150	60
Estimated Ottumwa Generating Station	--	0.55	0.033
Nitrogen Dioxide			
Primary Standard	--	--	100(0.05)
Secondary Standard	--	--	100(0.05)
Estimated Ottumwa Generating Station	--	--	1.28(0.0007)

[a] The maximum 3-hour and 24-hour average concentrations are not to be exceeded more than once during a year.

[b] The annual average for particulate matter is computed as a geometric mean, whereas the annual average for sulfur and nitrogen dioxide is an arithmetic mean.

4.0219 The results of the ambient air quality monitoring program conducted at the Ottumwa Generating Station site showed that the

annual average background concentration of sulfur dioxide, suspended particulates, and nitrogen dioxide were 5.1 μg/m^3, 65.4 μg/m^3 and and 10.5 μg/m^3 respectively (see APPENDIX D). The predicted increase in the annual average pollutant levels due to the operation of the Ottumwa Generating Station are expected to be of a small magnitude as shown in Table 4-4.

4.022 Emissions dispersion analysis. In preceding subsections applicable federal and Iowa emission standards and ambient air quality standards were explained and the Ottumwa Plant air pollution control system was described. Fuel selection, equipment design, and the use of combustion gas cleaning equipment are required to comply with the most stringent of emission standards.

4.0221 Plant stack design is based upon ambient air quality standards. Ground level air pollutant concentrations resulting from atmospheric discharges of cleaned combustion gases must comply with the most stringent applicable ambient air quality standards. Stack design is accomplished by use of a computational model that estimates gaseous dispersion and resulting ground level concentrations of air pollutants discharged from alternative stack configurations. The computational model and data to which the model was applied are described in APPENDIX E. The dispersion analysis is summarized and discussed in the following paragraphs.

4.022 Ground level air pollutant concentrations resulting from plant discharges have been analyzed on the basis of the maximum legal air pollutant emission rates. It is expected that actual emission rates will be below these legal limits; however, this analysis provides the worst case evaluation of plant operation.

4.0223 The ambient air quality standards described above utilize 3-hour, 24-hour, and annual average periods. The analysis of the Ottumwa Generating Station air pollutant discharges utilize these averaging times and maximum ground level concentrations have been estimated for each of these time periods as shown in Table 4-5.

TABLE 4-5

ESTIMATED MAXIMUM GROUND LEVEL AIR POLLUTANT CONCENTRATIONS RESULTING FROM OPERATION OF THE 727 MW (GROSS) UNIT AT MAXIMUM CAPABILITY WITH MAXIMUM LEGAL AIR POLLUTANT EMISSIONS DISCHARGED FROM A 600-FOOT STACK

	Estimated Maximum Average Ground Level Concentration		
Air Pollutant	3-Hour Average $\mu g/m^3$(ppm)	24-Hour Average $\mu g/m^3$(ppm)	Annual Average $\mu g/m^3$(ppm)
Sulfur Dioxide	72(0.027)	24(0.009)	1.4 (0.0005)
Particulate Matter	—	0.55	0.033
Nitrogen Dioxide	—	--	1.28(0.0007)

4.0224 In Table 4-6, the estimated ambient air concentrations of SO_2 and TSP due to emissions from OGS are compared to the prevention of significant deterioration increments for these pollutants. The diversion modeling indicates that emissions from OGS will not cause a violation of TSP or SO_2 deterioration increment.

4.0225 The maximum expected ground level concentrations of trace elements and the minimum concentration detectable by emission spectroscopy, are shown in Table 4-7. The trace elements are dispersed in two forms, as gaseous compounds of the element itself, and as a component of the fly ash.

4.02251 The first part of Table 4-7 shows the elements which would be oxidized at the temperatures within the boiler, and would form gases, i.e. arsenic; mercury, and selenium. Once these gases were emitted from the chimney, they would be dispersed in the same pattern as sulfur dioxide. The ground level concentrations shown were calculated on this basis. The table also shows that the ground level concentrations are far below the minimum detectable levels and the limits for human exposure.

4.02252 The second part of Table 4-7 shows the maximum expected ground level concentrations of fly ash. The concentrations of the trace elements in the fly ash is shown in Table 4-8. Because the fly ash is dispersed over a wide area and contains only minute

TABLE 4-6

COMPARISON OF SIGNIFICANT DETERIORATION AMBIENT AIR QUALITY INCREMENT WITH ESTIMATED MAXIMUM GROUND LEVEL AIR POLLUTANT CONCENTRATIONS RESULTING FROM OPERATION OF GENERATING UNIT AT MAXIMUM CAPABILITY WITH MAXIMUM LEGAL AIR POLLUTANT EMISSIONS DISCHARGED FROM A 600-FOOT STACK

MICROGRAMS PER CUBIC METER (PARTS PER MILLION)

	3-Hour		24-Hour		Annual	
Parameter	Increment	Plant	Increment	Plant	Increment	Plant
Sulfur Dioxide	700(0.27)	72(0.027)	100(0.09)	24(0.009)	15(0.006)	1.4(0.0005)
Particulate Matter	—	—	30	0.55	10	.033

TABLE 4-7

TRACE ELEMENTS CONCENTRATIONS--OTTUMWA GENERATING STATION MAXIMUM EXPECTED GROUND LEVEL CONCENTRATIONS

		Gaseous Concentrations--ppb (mg/m^3)			
Component	Stable Form In Flue Gas	3-Hour Average	24-Hour Average	Annual Average	Limits for Human Exposure (mg/m^3)
Arsenic	As_2O_3	0.0435 (0.054)	0.0145 (0.018)	0.00087 (0.001)	0.5
Boron	B_2O_3	1.01 (1.260)	0.335 (0.418)	0.0201 (0.025)	15.0
Bromine	$CaBr_2$	0.0319 (0.04)	0.0106 (0.012)	0.00064 (0.0008)	0.7
Chlorine	$CaCl_2$	0.872 (1.090)	0.291 (0.363)	0.0174 (0.022)	
Fluorine	CaF_2	0.089 (0.111)	0.0297 (0.037)	0.00178 (0.0022)	2.5
Iodine	I_2	0.0017 (0.002)	0.00057 (0.001)	0.00003 (0.00004)	10.5
Mercury	HgO	0.0008 (0.001)	0.00027 (0.0003)	0.000016 (0.00002)	0.1
Rubidium	Rb_2O_3	0.0124 (0.0155)	0.00414 (0.00518)	0.00025 (0.0003)	
Selenium	SeO_2	0.0041 (0.005)	0.00138 (0.002)	0.000083 (0.0001)	0.2

	Particulate Concentrations (mg/m^3)		
Component	3-Hour Average	24-Hour Average	Annual Average
Fly Ash	1.62	0.55	0.033

TABLE 4-8

FLY ASH TRACE ELEMENT ANALYSIS
OTTUMWA GENERATING STATION

Element	Stable Form in Fly Ash	Concentration in Fly Ash ppm
Barium	$BaO-BaSO_4$	1503-5598
Beryllium	BeO	4.8-38.5
Cadmium	CdO	7.9-19.8
Cerium	$CeO_2-Ce_2O_3$	244-974
Chromium	Cr_2O_3	355-2432
Cobalt	CoO	66-154
Copper	CuO	347-781
Gallium	Ga_2O_3	233-606
Iron	Fe_2O_3	135,786
Lanthanum	La_2O_3	163-406
Lead	PbO	18.7-74.6
Lithum	$LiOH$	12.9-172
Manganese	MnO_2	164-905
Molybdenum	MoO_3	78-338
Neodymium	Nd_2O_3	23.5-93.9
Nickel	NiO	110.3-308
Niobium	Nb	17.3-86.6
Praseodymium	Pr_2O_3	8.1-40.6
Samarium	Sm_2O_3	16-40.2
Strontium	SrO	2664-5636
Thorium	ThO_2	39.4-59.2
Tin	SnO	7.9-15.7
Titanium	TiO_2	10,262-18,212
Uranium	UO_2	39-59
Vanadium	V_2O_3	714-2754
Yttrium	Y_2O_3	220-1012
Zinc	ZnO	108-496
Zirconium		190.6-918

quantities of trace elements, the trace elements should not present any threat to plant or animal life.

4.02253 The maximum emission concentrations of trace elements expected from the Ottumwa Generating Station together with the limits for human exposure are shown in Table 4-9. The trace elements listed will be contained in the fly ash that is emitted from the stack. The electrostatic precipitator will remove 99.4 per cent of the ash, and only 0.6 per cent will be emitted. The concentrations of trace elements given in Table 4-9 are well below the limits of human exposure. Generally, the quantities are so small that they cannot be detected by the analytical techniques presently available.

4.02254 The fly ash collected by the electrostatic precipitator system will be transported by water (sluiced) to the ash storage pond. Since the ash will be carried by water, there will be no release of ash particles to the atmosphere. The ash pond is lined with a natural layer of clay which will prevent leaching of heavy metals from the pond. (See Section 4.02413, page IV-29.)

4.02255 The estimated amounts of trace elements that will be disposed in the ash pond and emitted from the stack during the 30-year life of OGS are given in Table 4-10. It is evident that the majority of the materials will be confined to the ash storage pond. As shown in Table 4-9, the maximum expected concentrations of trace elements contained in the stack emissions will be far less than the limits for human exposure, and they also should have no adverse impacts on fauna and flora on or near the site area.

4.023 Noise effects. From a technical point of view, noise is discordant sound resulting from nonperiodic vibrations in air. Noise is more simply defined as unwanted sound and has sometimes been termed sound without value. Sound generally refers to any audible disturbance of the air, while noise refers to a particular type of sound, usually discordant. Sound generally is said to become noise when it becomes a nuisance, either because of the quality of the sound, the loudness, or both. A certain type of sound may be agreeable sound to one listener and an objectionable "noise" to another. A sound level that is pleasing to one listener could be too soft for another or too loud for a third. The disturbance characteristics of noise are subjective and not easily quantifiable.

4.0231 The Environmental Protection Agency (EPA) has established guidelines for state and local governments to use in setting noise standards[4]. The Ottumwa noise study will be compared to four of the more significant EPA noise level guidelines: $L_{eq(24)}$, L_{dn} Outdoors, L_{dn} Indoors, and L_n Sleep. $L_{eq(24)}$ is set at 70 dBA and represents

TABLE 4-9
MAXIMUM EMISSION CONCENTRATIONS OF TRACE ELEMENTS IN FLY ASH EXPECTED FROM OTTUMWA GENERATING STEAM COMPARED TO LIMITS FOR HUMAN EXPOSURE, MICROGRAMS PER CUBIC METER

Element	3-Hour Average	24-Hour Average	Annual Average	Limits of Human Exposure[a]
Barium	0.009	0.003	0.0002	0.5
Berylium	0.00006	0.00002	0.000001	0.002[b]
Cadmium	0.00003	0.00001	0.0000007	0.2[b]
Cerium	0.0015	0.00054	0.00032	0.2[b]
Chromium	0.002	0.0007	0.00004	0.5
Cobalt	0.00025	0.000085	0.000005	0.5
Copper	0.0013	0.0004	0.000025	1.0
Gallium	0.0005	0.0002	0.00001	
Iron	0.1	0.04	0.002	10.0
Lanthanum	0.00064	0.00022	0.000013	
Lead	0.0001	0.00004	0.000002	0.2[b]
Lithium	0.00028	0.000096	0.000006	
Manganese	0.0015	0.00051	0.00003	
Molybdenum	0.00055	0.00019	0.00011	
Neodymium	0.00013	0.000044	0.0000026	15.0
Nickel	0.0005	0.0002	0.00001	1.0
Niobium	0.00014	0.00005	0.000003	
Praseodymium	0.000063	0.00002	0.0000013	
Samarium	0.00006	0.00002	0.0000013	
Strontium	0.009	0.003	0.00018	
Thorium	0.0001	0.00003	0.000002	
Tin	0.00003	0.00001	0.0000006	
Titanium	0.52	0.18	0.01	
Uranium	0.0001	0.00003	0.000002	0.2
Vanadum	0.0044	0.0015	0.00009	0.5
Yttrium	0.0017	0.00059	0.000035	1.0
Zinc	0.0008	0.0003	0.00001	5.0
Zirconium	0.0015	0.0005	0.00003	5.0

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[a] Title 29, Code of Federal Regulations, Part 1910.1000. Established by OSHA for an 8-hour shift.

[b] 8-hour time weighted average.

TABLE 4-10

ESTIMATED AMOUNTS OF TRACE ELEMENTS ASSOCIATED WITH THE OPERATION OF OGS FOR 30 YEARS

(55.8 Percent Average Load Factor)

Element	Total Amount Disposed in Ash Pond tons	Total Amount Emitted From Stack tons
Arsenic	0	73-292
Barium	3721-13,864	18-67
Beryllium	7.3-58.4	0.035-0.28
Boron	14.4-59	645-265.3
Bromine	1.5-21.9	13.2-198
Cadmium	29-73	0.14-0.35
Cerium	438-1751	2.1-8.4
Chlorine	160-1356	1452-12,237
Chromium	511-3502	2.5-16.9
Cobalt	219-511	1.0-2.5
Copper	1168-2627	5.6-12.7
Fluorine	2333-18,739	726-583
Gallium	365-950	1.75-4.6
Iodine	0	7.3-14.6
Iron	199,935	964
Lanathanum	292-730	1.4-3.5
Lead	73-292	0.35-1.4
Lithium	29.2-219	0.14-1.05
Manganese	438-2408	2.1-11.6
Mercury	2-4.2	0.19-9.75
Molybdenum	219-949	1.05-4.6
Neodium	36.5-146	0.17-0.7
Nickel	365-1022	1.7-4.9
Niobium	73-365	0.35-1.7
Praseodymium	14.6-73	0.07-0.35
Rubidium	68.5-1302	4.4-83.6
Samarium	29.2-73	0.14-0.35
Selenium	1.2-4.2	13.5-47.1
Strontium	9486-20,066	45.7-96.8
Thorium	146-219	0.7-1.05
Tin	29-58.4	0.14-0.28
Titanium	25,880-45,927	125-222
Uranium	146-219	0.7-1.05
Vanadium	1021-3937	4.9-19
Yttrium	365-1677	1.75-8.1
Zinc	365-1677	1.75-8.1
Zirconium	802-3864	3.87-18.6

the maximum allowable sound energy averaged over a 24-hour period which will prevent hearing loss (indoors and outdoors). The L_{dn} Outdoors is set at 55 dBA and represents the maximum allowable energy level over a 24-hour period to prevent conversation interference, outdoor activity interference and annoyance in residential areas and farms, other outdoor areas where people spend widely varying amounts of time, and other places in which relative quiet is a condition for use. The L_{dn} Indoors is set at 45 dBA and represents the maximum allowable energy level over a 24-hour period to prevent indoor activity interference and annoyance in indoor residential areas. Finally, the L_n Sleep is set at 32 dBA and represents the EPA recommendation of the maximum allowable energy level between the hours of 2200 and 0700 to prevent sleep disturbance. The EPA states that these levels are not to be construed as standards since they do not take into account cost or feasibility. Nor should they be thought of as discrete numbers, since they are defined in terms of energy equivalents[5].

4.0232 The predicted values of noise levels to be presented are considered high. The model used calculate attenuation considered only source strength, decay with distance, and molecular air absorption. No consideration was given to attenuation which might result from terrain irregularities, wind, vegetation, or other factors. The noise values at any point outside the station boundary are expected to be lower than the values predicted by the model.

4.0233 The first step in the study of noise from station operation was to determine the most likely sources for noise. In this particular case the sources determined were the river intake pumps, the main cooling tower fans, the bus tie transformer, the steam generator, the turbine, the precipitator, the coal crusher, and the rotary car dumper.

4.0234 Values for the noise output of each source were determined, either through manufacturer's data or mathematical models. Geographic coordinates, including height above grade, were given to each source and to the boundaries of the area under consideration.

4.0235 A background noise level of 35 dBA was assumed for the Ottumwa Site area, as the setting is rural with no nearby interstate highways or large cities. There is noise from the traffic on the roads in the area and from agricultural operations. The background and all other noise levels considered in development of the contours were derived from worst possible conditions. Actual conditions, therefore, will not exceed predictions.

4.0236 The octave noise spectra for each source, source coordinates, source height, the area of ground to be considered, and the background noise level were all inputs to a model which yielded an isopleth of noise values as shown on Figure 4-5. This figure displays the sources of noise and the isolines of even numbered dBA.

4.0237 The Ottumwa Generating Station plant site is in rural Iowa, approximately 8 miles north of Ottumwa, Iowa. At this distance the operational noise from the facility will not be heard.

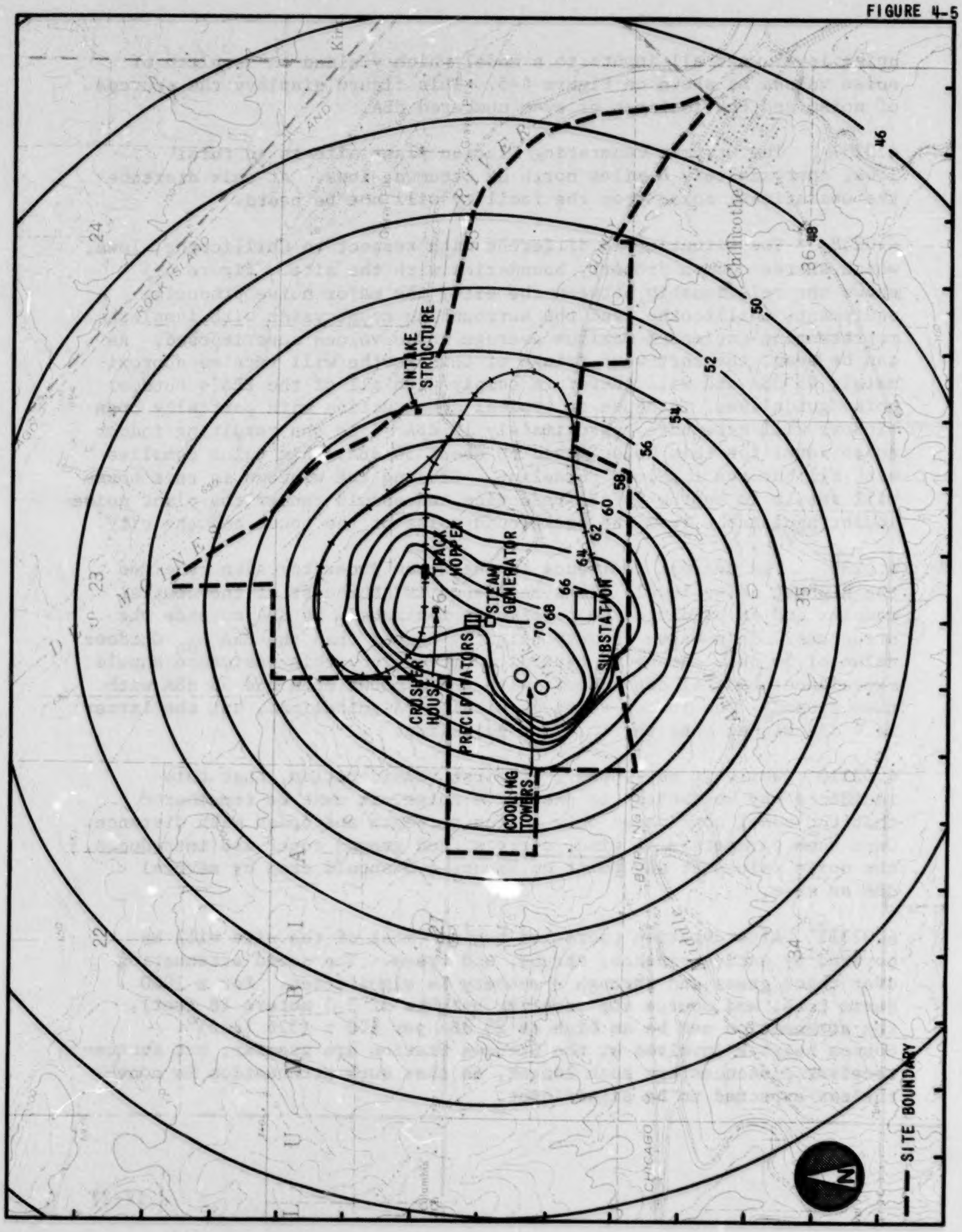
4.0238 The situation is different with respect to Chillicothe, Iowa, which shares common property boundaries with the site. Figure 4-5 shows the relationship between the site, the major noise producing equipment, Chillicothe, and the surrounding countryside with isopleths representing estimated maximum average noise values superimposed. As can be seen, the northwest fringe of Chillicothe will receive approximately 49 dBA and will therefore comply with all of the EPA's outdoor noise guidelines. A house of typical construction with partially open windows will attenuate approximately 15 dBA[6,7] so the resulting indoor noise level for this house would be about 34 dBA; this value complies with all but the L_n Sleep guideline. Closing the windows in this house will result in another 5 dBA reduction and should render the plant noise indistinguishable from the background noise of the house and the city.

4.0239 The nearest residence to the steam generator also receives the highest noise level. This residence is southeast of the central complex and is predicted to receive approximately 56 dBA outside the structure. This value is very slightly higher than the EPA L_{dn} Outdoor value of 55 dBA. Assuming typical construction, this residence should experience about 41 dBA indoors with the windows open and 36 dBA with them closed. The former value is within EPA guidelines, but the latter is 4 dBA higher than the L_n Sleep guideline.

4.02310 While it may appear, at first consideration, that this residence may be subject to excessive noise, it must be remembered that the model considered only source strength and decay with distance. Once such parameters as wind, terrain, and ground cover are introduced, the noise values at any point on Figure 4-5 should drop by several dBA or more.

4.02311 After station operation begins, most of the site will be covered by native grasses, shrubs, and trees. The sound attenuation over thick grass and through shrubbery is significant. For a 1000 hertz tone, and source and receiver heights of 2.5 meters (8 feet), the attenuation can be as high as 23 dBA per 100 m (326 feet)[8]. Source heights involved at the Ottumwa Station are greater, but source-receiver distances are much longer, so that such attenuation is nonetheless expected to be significant.

FIGURE 4-5



PREDICTED STATION OPERATION NOISE LEVELS IN dBA

4.02312 All other residences lie at greater distances from the noise source and will experience lower noise levels from station operation. The values given for noise levels produced by the Ottumwa Station represent predicted maximum average noise levels. Emergency situations could produce higher noise levels, but not for extended periods of time. Actual noise values should be less than these predicted values and should not create a community nuisance.

4.02313 An addition of three to five trains per week will travel the tracks to the OGS Site to supply the amount of coal needed for operation. The additional trains will be no louder than any of the other trains passing the site on a given day. Of the 210 trains that pass by the OGS site (see 4.01196), an additional three to five trains represents an increase of only 1.4 to 2.4 per cent which would increase the overall noise environment by a negligible amount.

4.024 Water Quality and Biological Elements

4.0241 Water quality. Since the generating station will incorporate a closed cycle cooling mode, the thermal impacts of plant operation on water quality and aquatic biota of the receiving water will be minimal. The cooling tower blowdown water will be taken from the cold side of the cooling tower and discharged to the ash sluice system and then to the bottom ash pond. The heat entering the ash pond will be dissipated by natural and forced evaporation as the pond will be an effective cooling lake. Calculations show that even during summer conditions of high humidity and temperature, the pond water will have a temperature not greater than 5 F above ambient temperature. Discharge from the pond will be minimal except during periods of high precipitation. The reuse of the cooling tower blowdown as ash sluice water and the long retention time in the ash pond will effectively remove any chlorine before discharge. Effluents from the ash pond will enter the river upstream from Avery Creek.

4.02411 Because of variations in the composition of coal and ash, a definitive chemical composition of discharge waters cannot be made. Experience has shown that an estimate can be made of the total dissolved solids (TDS) pickup and the TDS in discharge waters predicted. The 889,000 gpd discharge from the bottom ash pond will have approximately 3000 mg/l of TDS so 22,200 pounds per day of solids will enter the river from that source. The rainfall runoff from the coal storage area will have about 320 mg/l of TDS in the average flow of 53,000 gpd or 140 pounds per day.

4.02412 Based on a flow in the river of 300 cfs at the plant intake and a TDS in the river water of 536 mg/l, there will be 27,400 pounds per day less solids leaving with the discharge than entered with the raw water. Because of a consumptive use of water in the plant the concentration of TDS in the river downstream, after adequate mixing, will be about 548 mg/l.

4.02413 Very little historical data are available on the presence of toxic or hazardous materials in ash transport waters or coal pile runoff water. What little data are available indicate that materials which might be considered hazardous are present in such minute quantities that they are not readily detectable.

4.02414 The treated sewage effluent also will be discharged into the ash pond prior to entering the Des Moines River and will have no significant effect on the water quality of the river. Studies show that the ash pond will be essentially impervious and leachates are not expected to enter the Des Moines River or Avery Creek.

a. During December 1976, permeability tests were conducted by Patziz Testing Laboratories Co., Inc., Des Moines, Iowa on samples from nine borings. As shown on Figure 4-6 the borings were made within the ash storage areas and the coal storage area.

b. The permeability tests were conducted on 2 and 3 inch diameter, undisturbed, Shelby-tube samples taken at depths of from 1 to 6 feet. The falling-head tests of permeability were conducted under water pressures ranging from 4 to 14 pounds per square inch. Each sample was allowed to saturate and permeate for a period of 4 to 6 days before testing.

c. The results of the tests are shown in Table 4-11. The highest permeability measured was 1.06×10^{-7} cm/sec. All other values were in the range of 10^{-8} cm/sec. All of the samples tested are classified as practically impervious[9]. As an illustration, at the highest permeability measured, 1.06×10^{-7} cm/sec. there would be only a permeability of about 3 cm/year (under the laboratory test conditions stated). These test data support the conclusion that there will be virtually no leachates from the ash storage ponds or coal storage area. Groundwater level measurements made on June 19 and October 11, 1975 showed that the depth to groundwater varied from 4.6 feet to 47.7 feet from the lowest point within the ash pond. Using the highest permeability rate of 3 cm/yr, it would take 47.7 years for any water from the ash pond to reach an aquifer located at a depth of 4.6 feet.

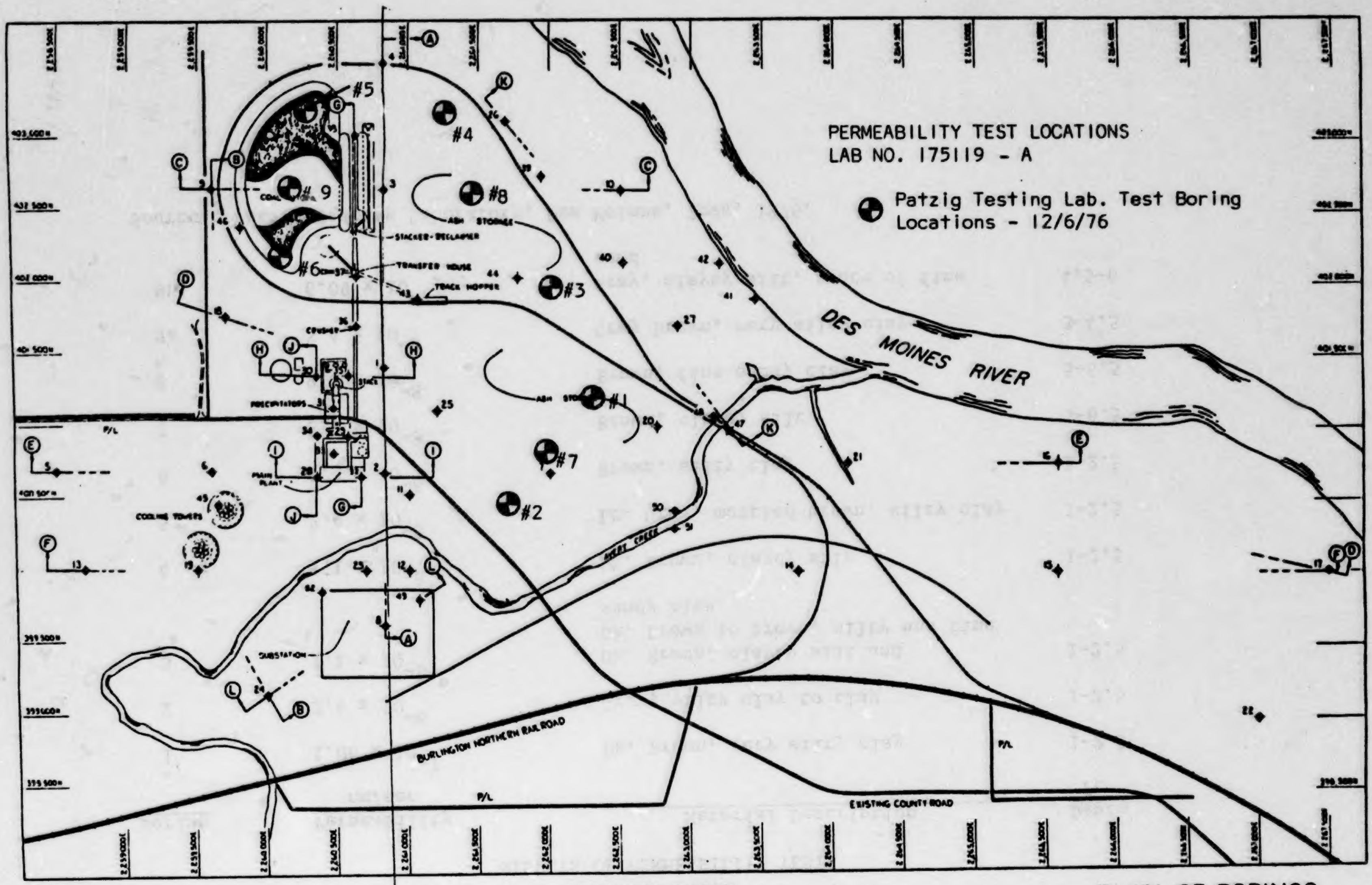
4.0242 Entrainment. Condenser entrainment can involve only those organisms small enough to pass through the meshes of the intake screen. Usually openings of 3/8 inch are used; thus eggs, sac-fry, and other small larval stages of fishes and planktonic

TABLE 4-11

RESULTS OF PERMEABILITY TESTS

Boring	Permeability cm/sec	Material Description	Depth ft
1	1.06×10^{-7}	Dk. Brown, very silty clay	1-2.5
2	2.4×10^{-8}	Gray, silty clay to clay	1-2.5
3	2.1×10^{-8}	Dk. Brown, clayey silt and Dk. Brown to brown, silty and fine sandy clay	1-2.5
4	1.1×10^{-8}	Dk. Brown, clayey silt	1-2.5
5	2.4×10^{-8}	Lt. Gray, mottled brown, silty clay	1-2.5
6	1.3×10^{-8}	Brown, silty clay	1-2.5
7	8.9×10^{-8}	Brown, clayey silt	5-6.5
8	9.3×10^{-8}	Brown, fine sandy clay	5-6.5
9a	5.4×10^{-8}	Gray brown, very silty clay	3-4.5
9b	6.09×10^{-7}	Gray, clayey silt, trace of fine sand	4.5-6

Source: Patzig Testing Laboratory, Des Moines, Iowa, 1976.



SOURCE: ATEC ASSOCIATES

PLAN OF BORINGS
OTTUMWA GENERATING STATION
CHILLICOTHE, IOWA

FIGURE 4-6

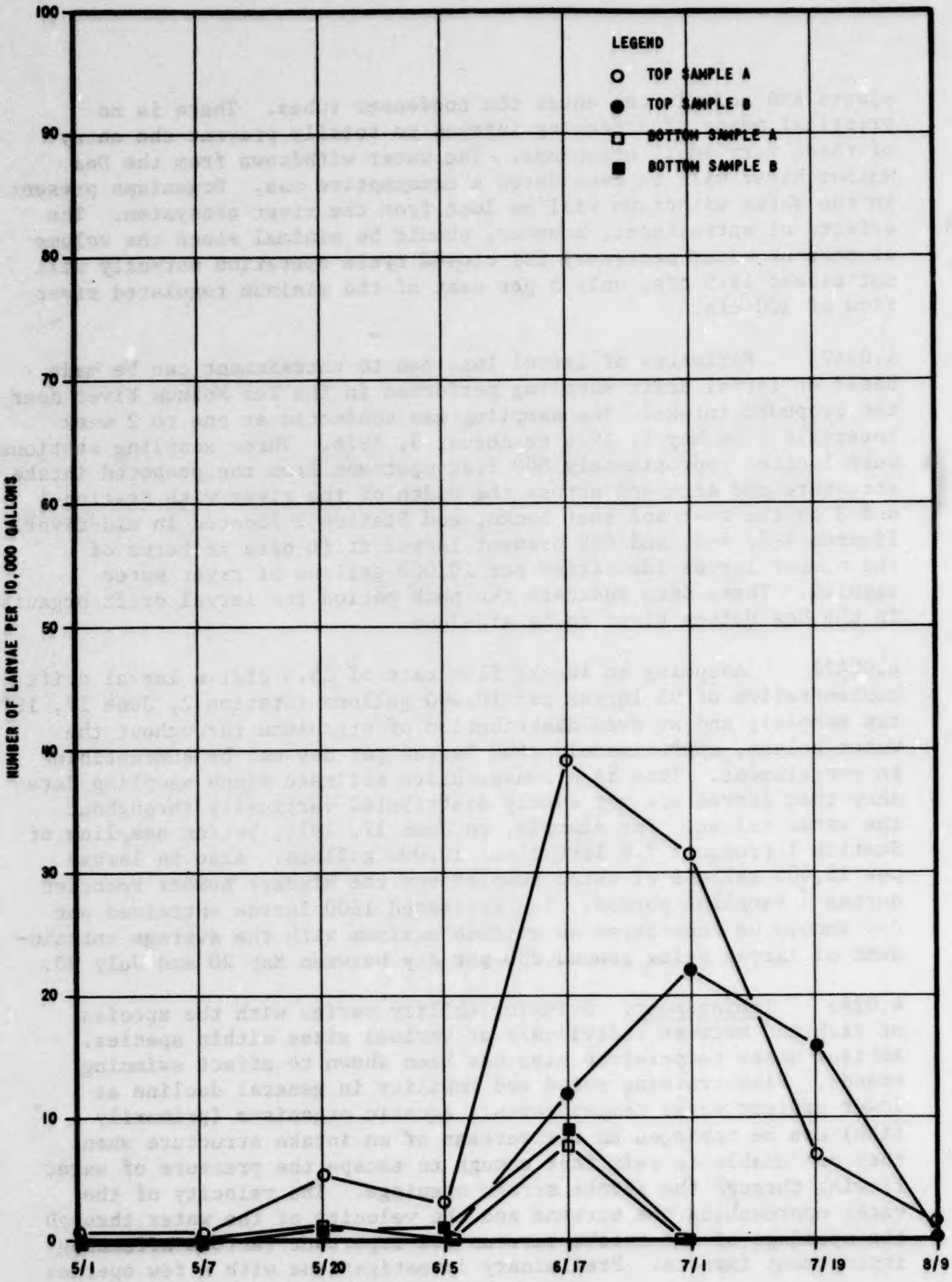
plants and animals can enter the condenser tubes. There is no practical means of screening intakes to totally prevent the entry of these very small organisms. The water withdrawn from the Des Moines River will be considered a comsumptive use. Organisms present in the water withdrawn will be lost from the river ecosystem. The effects of entrainment, however, should be minimal since the volume of make-up water necessary for closed cycle operation normally will not exceed 15.5 cfs, only 5 per cent of the minimum regulated river flow of 300 cfs.

4.02421 Estimates of larval loss due to entrainment can be made based on larval drift sampling performed in the Des Moines River near the proposed intake. The sampling was conducted at one to 2 week intervals from May 1, 1976 to August 9, 1976. Three sampling stations were located approximately 500 feet upstream from the proposed intake structure and arranged across the width of the river with Station 1 and 3 on the west and east banks, and Station 2 located in mid-river. Figures 4-7, 4-8, and 4-9 present larval drift data in terms of the number larvae identified per 10,000 gallons of river water sampled. These data indicate the peak period for larval drift organisms in the Des Moines River to be mid-June.

4.02422 Assuming an intake flow rate of 15.5 cfs; a larval drift concentration of 95 larvae per 10,000 gallons (Station 2, June 17, 1976, top sample); and an even distribution of organisms throughout the water column, approximately 1600 larval per day may be susceptible to entrainment. This is a conservative estimate since sampling data show that larvae are not evenly distributed vertically throughout the water column. For example, on June 17, 1976, bottom sampling of Station 1 produced 7.9 larvae per 10,000 gallons. Also 94 larvae per 10,000 gallons of water sampled was the highest number recorded during a sampling period. The estimated 1600 larvae entrained per day should be considered an extreme maximum with the average entrainment of larvae being around 250 per day between May 20 and July 30.

4.0243 Impingement. Swimming ability varies with the species of fish and between individuals of various sizes within species. Ambient water temperature also has been shown to affect swimming speeds. Fish cruising speed and mobility in general decline at lower ambient water temperatures. Aquatic organisms (primarily fish) can be impinged on the screens of an intake structure when they are unable to swim fast enough to escape the pressure of water flowing through the intake screen openings. The velocity of the water approaching the screens and the velocity of the water through the openings of the intake screens are important factors affecting impingement impacts. Preliminary investigations with a few species

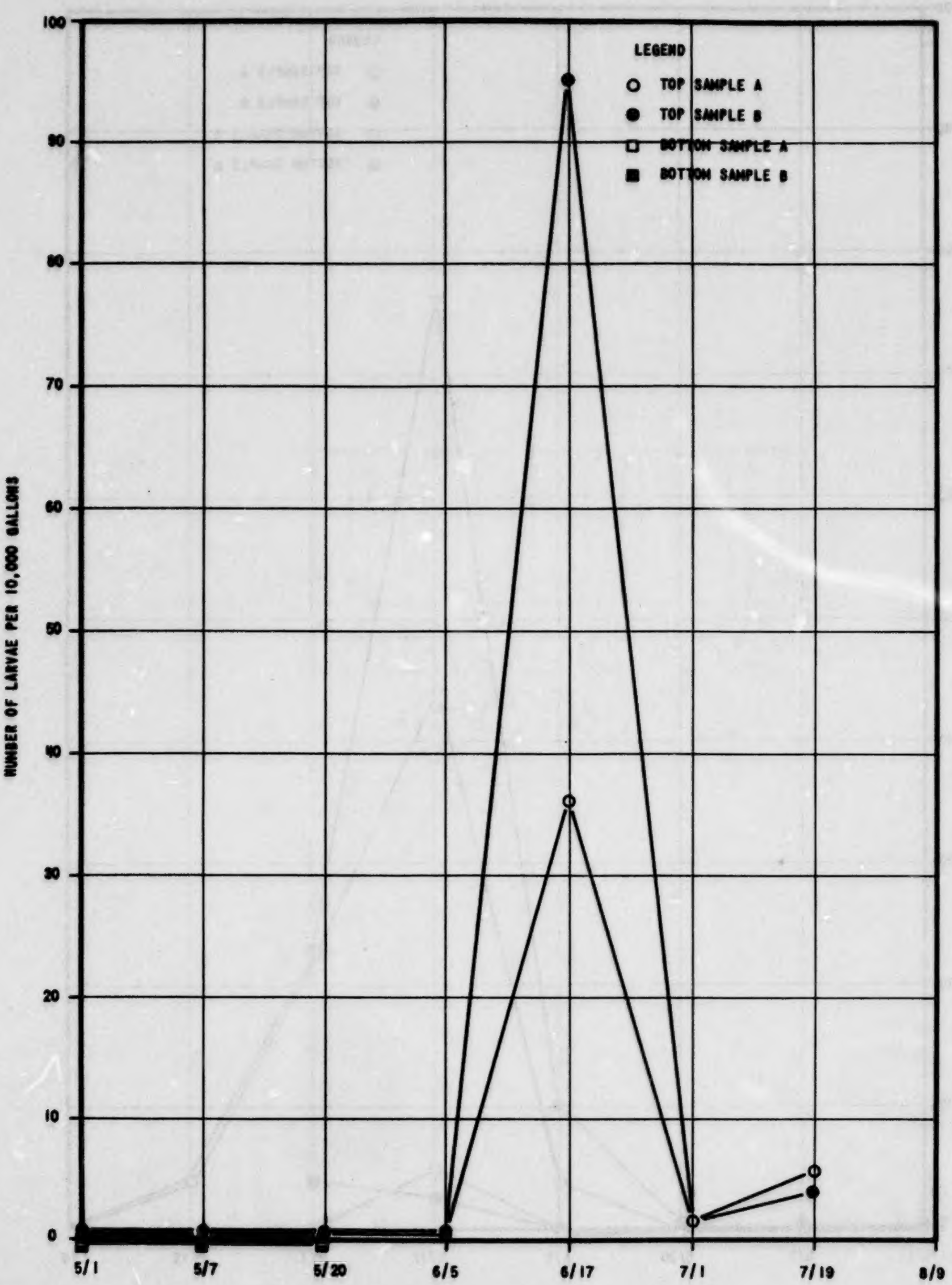
FIGURE 4-7



SOURCE: IOWA INSTITUTE OF HYDRAULIC RESEARCH, 1976

SUMMARY OF FISH LARVAE DATA, STATION I

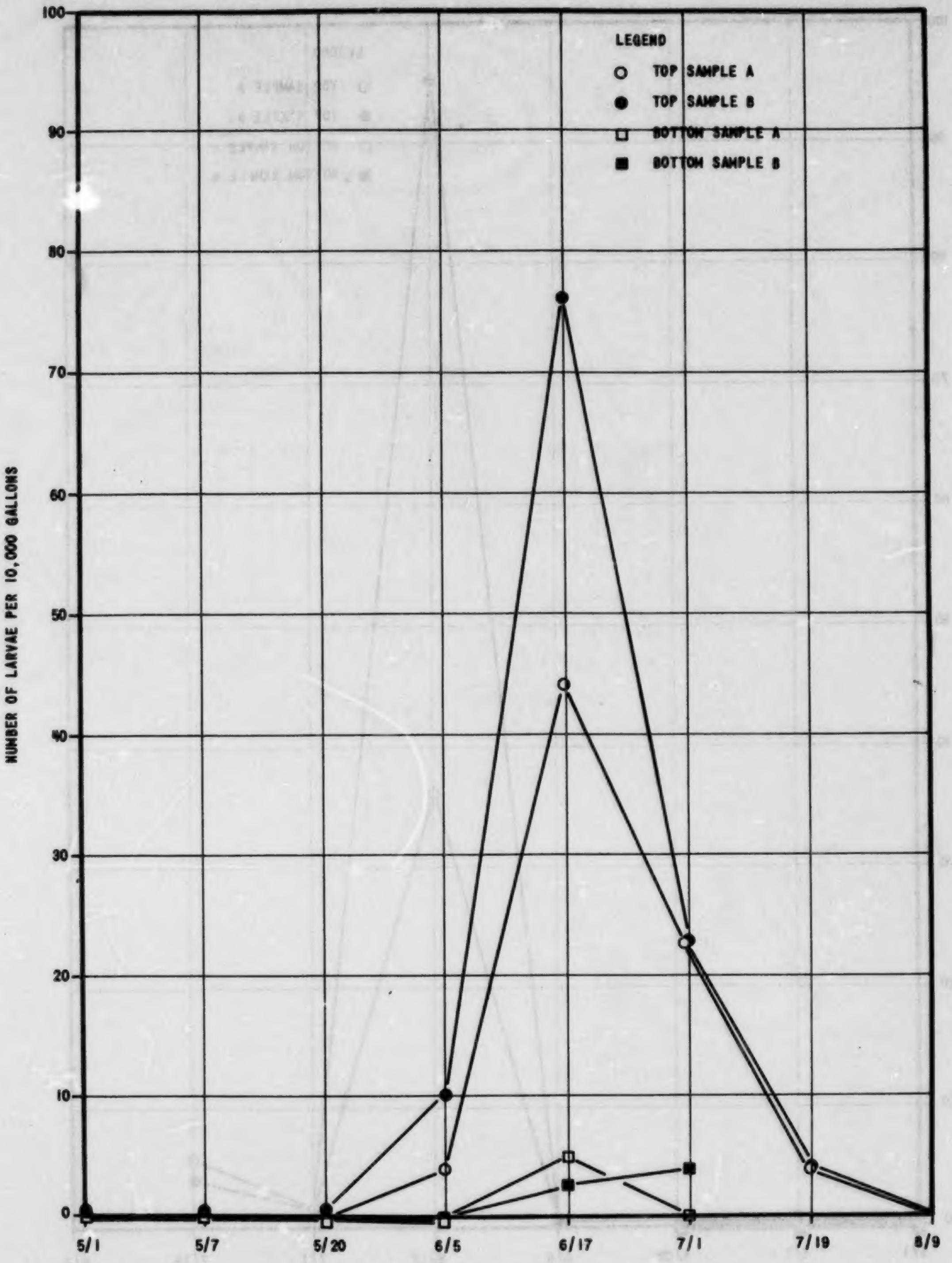
FIGURE 4-8



SOURCE: IOWA INSTITUTE OF HYDRAULIC RESEARCH, 1976

SUMMARY OF FISH LARVAE DATA, STATION 2

FIGURE 4-9



SOURCE: IOWA INSTITUTE OF HYDRAULIC RESEARCH, 1976

SUMMARY OF FISH LARVAE DATA, STATION 3

of fish indicate that approach velocities of less than one foot per second (fps) may be necessary to reduce impingement[10].

4.02431 Intake structure. A concrete intake structure (Figure 4-10) will be located at the shoreline of the Des Moines River at approximately River Mile 106. The river channel offers a relatively deep section at this location which will provide submergence for the circulating water pumps. The intake is located with the inlet side of the structure about parallel to the shoreline. The intake operating floor will be located to provide protection against a flood with a recurrence interval of 50 years (663 feet MSL). The inlet wall located on the river side of the structure will extend below the historical low water level to seal the structure and provide equipment protection from adverse moisture and temperature conditions. This wall will also be used in conjunction with concrete belt beams to protect the structure against ice and debris loading conditions.

a. The intake will be designed for one unit. The common intake cell incorporates a bar rack, stop log, vertical traveling screen, and two vertical pumps. The cell will be designed to provide a minimum practical approach velocity to bar racks and traveling screens with consideration given to economics, available equipment, and environmental impacts.

b. The OGS intake structure is designed for an intake screen velocity (velocity of the water passing through the openings in the screen) of 1.0 fps at a low water elevation of 639 feet MSL, and approximately 0.8 fps at a normal water elevation of 648 feet MSL. These two values represent approach velocities of approximately 0.50 and 0.40 fps, respectively.

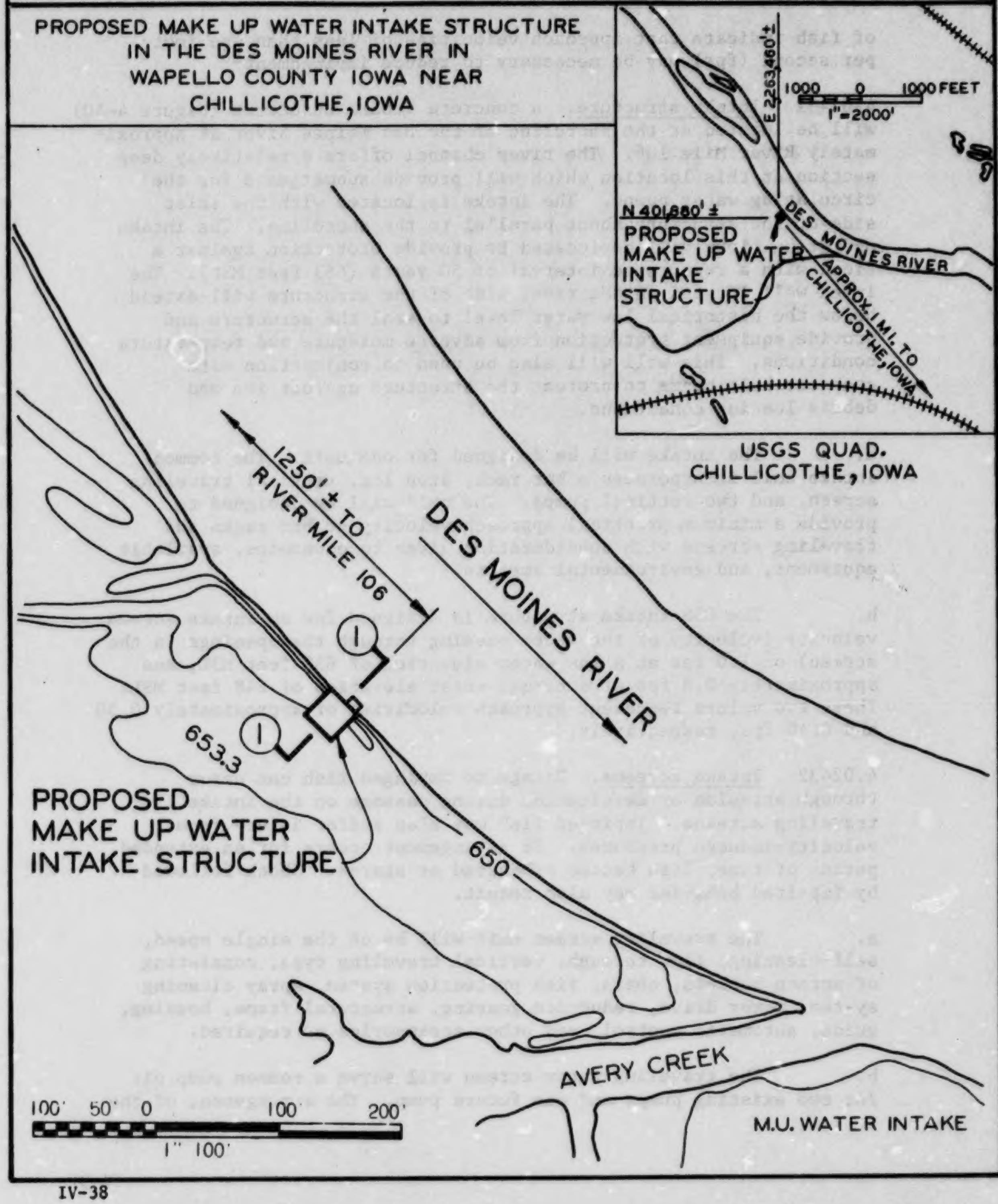
4.02432 Intake screens. Damage to impinged fish can occur through abrasion or dessication during passage on the intake traveling screens. Impinged fish may also suffer injury from velocity-induced pressures. If impingement occurs for an extended period of time, fish become exhausted or starve. Shock followed by impaired behavior may also result.

a. The traveling screen unit will be of the single speed, self-cleaning, flow through, vertical traveling type, consisting of screen baskets, chain, fish protection system, spray cleaning system, motor drive, reduction gearing, structural frame, housing, guide, automatic control, and other accessories as required.

b. The traveling water screen will serve a common pump pit for two existing pumps and one future pump. The arrangement of the

FIGURE 4-10

PROPOSED MAKE UP WATER INTAKE STRUCTURE IN THE DES MOINES RIVER IN WAPELLO COUNTY IOWA NEAR CHILLICOTHE, IOWA


E 2263,460' ±
1000 0 1000 FEET
1"=2000'
N 401,680' ±
PROPOSED MAKE UP WATER INTAKE STRUCTURE
DES MOINES RIVER
APPROX. 1 MI. TO CHILLICOTHE, IOWA
USGS QUAD. CHILLICOTHE, IOWA
1250' ± TO RIVER MILE 106
DES MOINES RIVER
1
1
653.3
650
PROPOSED MAKE UP WATER INTAKE STRUCTURE
AVERY CREEK
100' 50' 0 100' 200'
1" 100'
M.U. WATER INTAKE

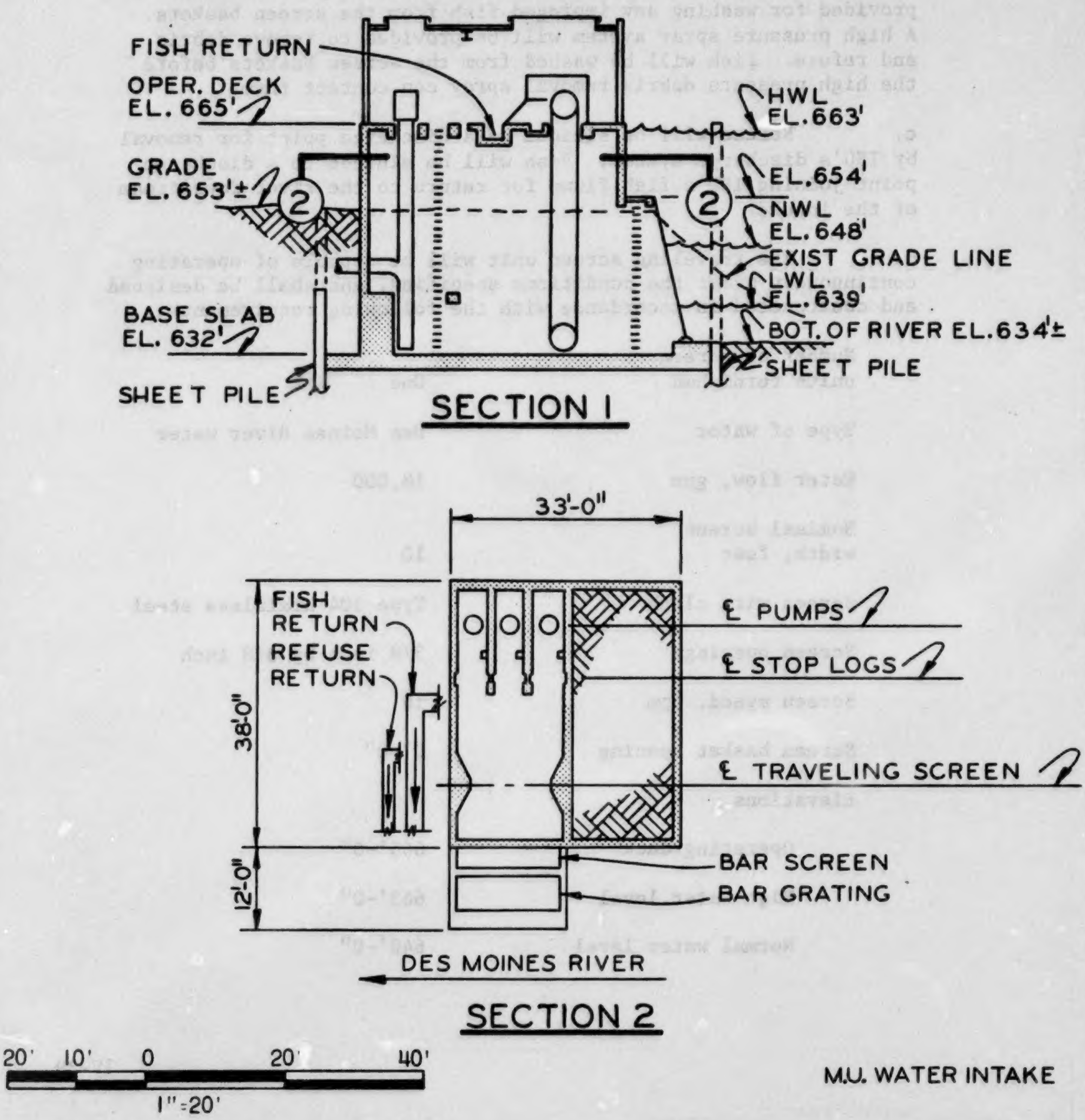
pumps and screen is as indicated on Figures 4-11 and 4-12. The traveling screen unit will have screen baskets mounted on two parallel strands of chain. The screen chains shall be suspended between the head and boot section assemblies of the main structural framing. The screen baskets will carry debris and refuse along with any captured fish above the operating floor where the screens will be cleaned by two water spray systems. A low pressure spray system will be provided for washing any impinged fish from the screen baskets. A high pressure spray system will be provided to remove debris and refuse. Fish will be washed from the screen baskets before the high pressure debris removal spray can contact them.

c. Refuse will be sluiced to a discharge point for removal by ISU's discharge system. Fish will be sluiced to a discharge point joining ISU's fish flume for return to the river downstream of the intake.

d. The traveling screen unit will be capable of operating continuously under the conditions specified, and shall be designed and constructed in accordance with the following requirements.

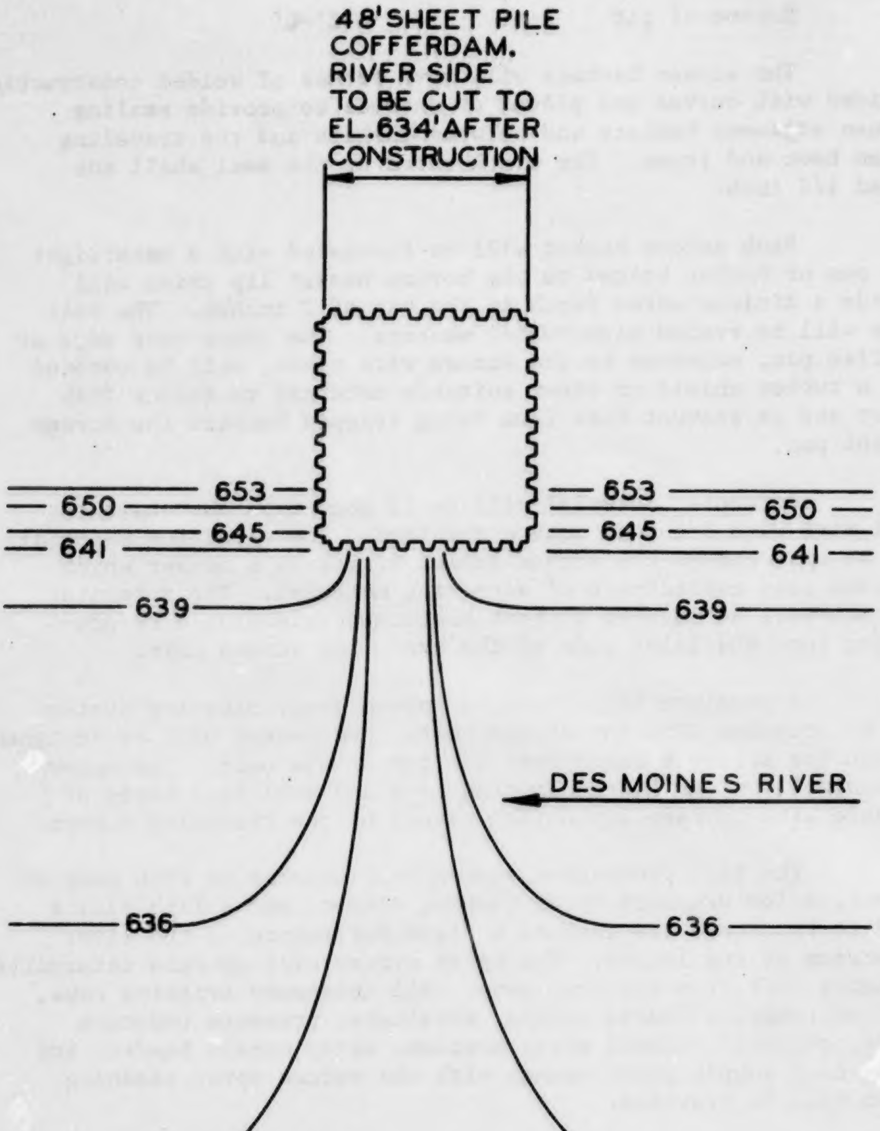
Number of screen units furnished	One
Type of water	Des Moines River water
Water flow, gpm	18,000
Nominal screen width, feet	10
Screen wire cloth	Type 304 stainless steel
Screen openings	3/8 inch by 3/8 inch
Screen speed, fpm	10
Screen basket spacing	2'-0"
Elevations	
Operating deck	665'-0"
High water level	663'-0"
Normal water level	648'-0"

FIGURE 4-11



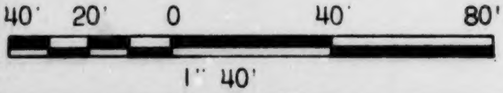
M.U. WATER INTAKE

FIGURE 4-12



PLAN

MAKE UP WATER SHEET PILING



M.U. WATER INTAKE

Low water level	639'-0"
Bottom of pit	632'-0"

e. The screen baskets will have frames of welded construction provided with curved end plates or shrouds to provide sealing between adjacent baskets and between baskets and the traveling screen boot and frame. The crack width at the seal shall not exceed 1/8 inch.

f. Each screen basket will be furnished with a watertight fish pan or bucket bolted to the bottom basket lip which will provide a minimum water depth in the pan of 2 inches. The bolt holes will be sealed with rubber washers. The upper rear edge of the fish pan, adjacent to the screen wire cloth, will be covered with a rubber shield or other suitable material to reduce fish injury and to prevent fish from being trapped between the screen and the pan.

g. Screening material will be 12 gage type 304 stainless steel wire with 3/8-inch square openings. The screening material will be attached to the screen basket frames in a manner which provides easy replacement of screening material. The screening material will be secured without bolting or clamping bars projecting into the inlet side of the traveling screen unit.

h. A complete high pressure refuse spray cleaning system will be provided with the screen unit. The system will be designed to wash the screen baskets near the top of the unit. The spray nozzles will be of the nonclogging type and will have bores of adequate size to pass any object passed by the traveling screen.

i. The fish protection system will consist of fish pans or buckets, a low pressure spray washing system, and a fish sluice chute to transport the fish to a flume for return to the river downstream of the intake. The spray system will operate intermittently to remove fish from the fish pans. All necessary tripping cams, limit switches, solenoid valves, strainers, pressure reducing valves, shut-off valves, spray nozzles, spray nozzle header, and piping to a supply point common with the refuse spray cleaning system will be provided.

4.02433 Location. Proper location is one of the most important ways to minimize impacts of intake structures[10]. A screen set flush with the face of an intake structure is less liable to trap fish than is one inset in a bay. The OGS intake structure has been located so that Des Moines River currents will tend to sweep any fish past the intake screens. The screen design will also aid in reducing damage to fish that become impinged. Dredging and filling operations during the construction of the intake structure will be in accordance with Section 404, PL 92-500, and subject to Environmental Protection Agency's Guidelines.

4.02434 Impingement problems are expected to be of minimal significance at Ottumwa Generating Station since the design of the intake structure is such that attraction of fish to the intake is not likely to occur. The small volume of water required for closed cycle operation and the fact that the approach velocity to the intake screens will not exceed 1.0 feet per second will further minimize the magnitude of impingement. Figures 4-3, 4-4 and 4-5 show the proposed location and design features of the intake structure. These design features include a vertical traveling screen and a fish return sluiceway to the Des Moines River. These design features, when combined with the low approach and intake velocities, will minimize impingement and entrainment impacts.

4.02435 It is nearly impossible to accurately estimate the magnitude of impingement at the Ottumwa Station since there are no power generating stations similar to the Ottumwa Station presently located on this stretch of the Des Moines River. Preliminary studies at ISU's Eddyville Station 7 miles upstream from the Ottumwa site indicate that impingement is an almost non-existent problem but the Eddyville Station is a far smaller closed cycle facility which currently operates on an intermittent basis. Some fish population data, particularly as is related to relative abundance, is available. Mayhew[11,12,13] conducted three studies of the population dynamics of the river from 1966 to 1968. Studies for the current EIS were also limited to assessing the relative abundance of species present rather than obtaining standing crop estimates, a far more complex and time consuming procedure.

a. Based on the above data, it is possible to arrive at a rough numerical estimate of the probable magnitude of impingement if two basic assumptions are made.

Assumption 1--The combined standing crop per acre for all species in the Des Moines River is similar to the Mississippi River at Quad-Cities, although the relative abundance is different.

Assumption 2--The composition of the fishery of the Des Moines River is still similar to that observed by Mayhew, which is generally consistent with the studies of relative abundance for the OGS ER.

b. Studies conducted by Commonwealth Edison Co.[13] at the Quad-Cities Station have provided extensive data on the standing crop of the Mississippi River and the magnitude of impingement at the station. It is evident from these data that relative abundance and swimming speed are not the major factors influencing the impingement of various species. Other factors such as schooling behavior and the propensity for attraction to warm waters must also be considered. For example, although gizzard shad account for only 22 per cent by weight of the standing crop of the Mississippi River, they made up almost 90 per cent by weight of the fish impinged in 1973. Similarly, carp which account for approximately 18 per cent of the standing crop made up only 0.4 per cent of the total impingement by weight in 1973. Thus it is possible, assuming similar propensity for impingement of a given species on the Des Moines and Mississippi Rivers, to calculate the relative magnitude of impingement expected with variations in abundance of different species. Since the volume of water entering the station will also influence the impingement numbers, the effect of this parameter on the expected magnitude of impingement can be predicted.

c. The following has been used to estimate the magnitude of impingement expected at the Ottumwa Station (Table 4-12).

Column A--Lists the significant species of fish found in both rivers.

Column B--Gives the per cent by weight of the estimated standing crop for each species at Quad-Cities as determined by the Commonwealth Edison studies.

Column C--Gives the pounds of each species removed by impingement at Quad-Cities in 1973.

d. These low values are in accordance with the impingement results from the Duane Arnold Energy Center, a closed cycle nuclear generating station located on the Cedar River which withdraws 24.5 cfs (maximum) of makeup water. Studies conducted at this station during 1974 and 1975[14,15] indicate that frequently no fish whatsoever are impinged during a 24-hour period and the maximum number of fish impinged within a 24-hour period was 33 with a combined weight of less than one-half pound. Young-of-the-year channel catfish were the form most commonly impinged at the Duane Arnold Energy Center.

e. Regarding periods of maximum impingement it is likely that for most species (particularly gizzard shad, drum, catfish and white bass) young-of-the-year individuals will be impinged

TABLE 4-12

SUMMARY OF IMPINGEMENT DATA AT QUAD-CITIES (1973) AND PROJECTED IMPINGEMENT AT OTTUMWA GENERATING STATION.

A Significant Fish Species (both river systems)	B % (by wt.) of standing crop Mississippi River	C Removal (pounds) by impingement at Quad-Cities in 1973[1]	D % of total impingement (by wt.) at Quad-Cities for each species[1]	E % relative abundance (by wt.) of fish species - Des Moines River (1968 & 1975)[2,3]	F Estimated standing crop per acre in Des Moines River (Col. E x 397 lbs. per acre)	G Expected removal (lbs.) at Quad-Cities if relative abundance similar to Des Moines River (E÷B) x C	H Expected removal at Ottumwa (lbs/yr) (G ÷130)
Carp	18	385	0.4	18[2]	72	385	2.9
Carp-sucker	18	136	0.1	26[2]	103	196	1.5
Gizzard Shad	23	93,865	90.4	0.5[3]	2	2,040	15.7
Drum	8	3,459	3.3	0.4[3]	2	173	1.3
Channel Catfish	4	901	0.9	50[2]	198	11,262	87
White Bass	0.2	490	0.5	0.2[3]	1	490	3.8
Other*	28.8	4,590	4.4	4.9	19	781	6.0
Total		103,826					118.2

*Others include buffalo, walleye, bluegill, crappie, northern redhorse

1. Commonwealth Edison Co. 316(b) (1975)
2. Mayhew, Jim, 1969, Report on the Third Year Study of Commercial Fish Species in the Des Moines River and Coralville Reservoir, Biology Section, Commercial Fisheries Report, Project 4-11-R-3.
3. Ottumwa EIS, Fishery Date (1975)

following spawning periods. Based on the Quad-Cities studies it is likely that most gizzard shad will be impinged during the September-January period, especially if recirculation of heated water into the intake structure is necessary. Gizzard shad are commonly attracted to warm water areas during the winter months and are particularly prone to impingement due to their slow swimming speeds. Channel catfish impingement has also been observed to increase during the fall and winter periods. Impingement of drum at Quad-Cities was generally found to be highest in early spring and early fall.

4.025 Economic and Social Effects

4.0251 Introduction. The direct and indirect effects of the operation of OGS and corresponding impacts on the projected levels of economic activity in the Primary Area are considered in this section. These effects will commence upon completion of the construction phase in 1981 and will continue as long as OGS is in operation. The economic and social impacts of the project in the Primary Area are determined by comparing the "with OGS" and "without OGS" projections of economic activity. All operation phase cumulative impacts are shown in Table 4-13. The results of the operation of OGS which generate impacts in the Station Site, Primary Area and Secondary Area include the manpower necessary to run the plant, staff payrolls and property tax revenues in the Station Site, Primary and Secondary Areas. These direct effects of operation create additional indirect effects in the form of stimulated regional economic activity. Changes in the levels of personal income, employment, and property tax revenues caused by the operation of OGS create additional indirect impacts on the regional economy.

4.0252 Direct operation effects. As discussed in Section 4.0241, direct effects of the operation of OGS in the Primary Area include increased personal income due to permanent staff payrolls, additional employment caused by the need for operating personnel and more property tax revenues generated by the inclusion of OGS capital investment in the tax base. The magnitude of these effects is reflected in Table 4-14. It should be noted that most of the additional jobs created by the operation of OGS will be filled by local residents. Outside of the Primary Area the only significant effect of the operation of OGS will be on property tax revenues. The increased property tax base will generate additional revenues which benefit the Secondary and External areas. The magnitude of these revenues is indicated in Table 4-14.

TABLE 4-13

CUMULATIVE DIRECT AND INDIRECT ECONOMIC IMPACTS DURING OGS OPERATION (1982-2010) 1981 DOLLARS

	Impact	Percentage Increase Due to OGS Impact
Employment, Man-Years	1,856	0.15
Personal Income	43,413,000	0.25
Wages & Salaries	38,048,000	0.43
Profit & Proprietor Income	5,365,000	0.09
Disposable Income	40,745,000	0.26
Federal Income Tax Revenues	1,720,667	0.16
State Income Tax Revenues	942,500	0.36
Retail Sales	7,472,333	0.10
Retail Sales Tax Revenues	275,500	0.11
Bank Deposits, $-Years	3,765,167	0.03
Farm Income	-3,694,167	<0.27>
Real Estate Sector (APV, REV, PSV, VFLB)	Positive Impact	*
Property Tax Revenues (Direct and Indirect)	Positive Impact	*

*Not available.

TABLE 4-14

DIRECT OPERATION EFFECTS WITH OGS

Average Annual Permanent Staff Payroll (1981 $)	$ 976,206
Annual Employment, Man-Hours	$ 100,000
Estimated Annual Property Tax Revenues[a] in Station Site (1981 $)	$1,230,000
Estimated Annual Property Tax Revenues[a] in Secondary & External Areas (1981 $)	$7,999,000
Annual Value of Cropland Removed from Production	$ 125,830
Inflated Annual Value of Cropland Removed from Production (1981 $)	$ 158,495

[a] See Table 4-2, Property Tax Revenues, 1982.

4.02521 Loss of crop production on station site. Previous owners of site acreage were allowed to continue farming in 1975. A total of 301 acres of corn and 147 acres of soybeans were planted. The approximate remaining balance of the 795 acres consists of 88 acres of hay meadow and 259 acres of rough pasture woodlands. Present plans are not to disturb the land containing 77 acres of corn and 45 acres of soybeans during the OGS operating life. All other production will be eliminated. Therefore, crop losses based on 1975 production will equal 224 acres of corn, 102 acres of soybeans, and 88 acres of hay meadow. The Wapello County Extension Service, Iowa State Agriculture Department, suggests a value of $420/acre for corn, $260/acre for soybeans, and $30/acre for hay meadow; with a grazing value of $10/acre for the balance of the acreage. Annual crop loss in 1975 dollars would then be $94,080 for corn, $26,520 for soybeans, $2640 for hay meadow, and $2590 for rough pasture; a total of $125,830.

4.02522 Dislocation of site residents. There are presently two families and one single person living on the site, totaling 11 persons. All of these residents must relocate. No other dislocations will be required.

4.0253 Indirect operation effects. The indirect effects of the operation of OGS are a result of increased economic activity due to permanent operating staff payroll multiplier effects in the Primary Area. All of the other indirect operation phase impacts shown in Figure 4-2 result from the permanent crew, their families, and the income and expenditures made by them. The indirect operation impacts represent a small portion of projected economic activity and are virtually insignificant.

4.02531 In its 1975 Areawide Overall Economic Development Plan, the Area XV regional planning commission discusses the expansion of industrial facilities in its planning district. It is their hope that enough additional industry can be attracted into the area in order to support the desired rate of economic growth. Since proximity to a power source does not result in lower electric rates, it is not expected that the location of OGS in the area will stimulate industrial development in any way other than simply expanding the capacity of the entire ISU system.

REFERENCES

1. Office of Noise Abatement and Control, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, 550/9-74-004, U.S. Environmental Protection Agency, Washington, D.C., March 1974, p. 3.

2. Bolt, Beranek, and Newman, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID 300.1, U.S. Environmental Protection Agency, Washington, D.C., December 31, 1971, p. A-1, A-39.

3. Ibid, pp. B-6 to B-11.

4. Office Noise Abatement and Control, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety, #550/9-74-004, U.S. Environmental Protection Agency, Arlington, Virginia, March 1974, p. 3.

5. Ibid., p. 4.

6. Office of Noise Abatement and Control, Ibid., pp. 21-22.

7. Office of Noise Abatement and Control, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID 300.1, U.S. Environmental Protection Agency, Washington, D.C., December 31, 1971, pp. B-8 to B-10.

8. L. L. Beranek, ed., Noise and Vibration Control, McGraw-Hill, Inc., New York, 1971, pp. 182-184.

9. Davis, S. N. and R. J. M. DeWeist, Hydrogeology, John Wiley & Sons, Inc., p. 164, 1966.

10. U.S. Environmental Protection Agency, 1973, Development Document for Proposed Best Technology Available for Minimizing Adverse Environmental Impact of Cooling Water Intake Structures, U.S. Environmental Protection Agency.

11. Mayhew, J. and Mitzner, L., 1967 "Report on the First Year Study of Commercial Fish Species in the Des Moines River and Coralville Reservoir," Biol. Sec. Commercial Fisheries Report, Ia. Cons. Comm. Proj. 4-11-R-1.

REFERENCES (Continued)

12. Mayhew, J. and Mitzner, L., 1968, "Report on the Second Year Study of Commercial Fish Species in the Des Moines River and Coralville Reservoir," Biol. Sec. Commercial Fisheries Report, IA. Cons. Comm. Proj. 4-11-R-2.

13. Mayhew, J. and Mitzner, L., 1969, "Report on the Third Year Study of Commercial Fish Species in the Des Moines River and Coralville Reservoir," Biol. Sec. Commercial Fisheries Report, IA. Cons. Comm. Proj. 4-11-R-3.

14. Commonwealth Edison Co. (1965) "Three-Sixteen a and b Demonstration - Quad-Cities Nuclear Station-Mississippi River," submitted to the U.S. EPA November 1975.

15. McDonald, D. G., "Cedar River Baseline Ecological Study Annual Report - January 1974-1975," report submitted to Iowa Electric Light and Power Company, August 1975.

16. McDonald, D. G., "Cedar River Baseline Ecological Study Annual Report - January 1975-January 1976," report submitted to Iowa Electric Light and Power Company, April 1976.

V PROBABLE ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED

5.01 Impacts of Construction Activities.

5.011 Terrestrial Environment. There will be a loss of some forest and grassland which presently provide habitat for mammals, birds, herptiles, insects, and invertebrates. There will be a permanent distruption of normal succession and changes in ecological recycling and productivity. Most of the 795 acre site that is presently utilized for agricultural purposes will be diverted to industrial use; i.e. production of electrical energy. The presence of the generating station will distract to some extent from the aesthetic character of the predominantly rural area.

5.012 Water Quality and Biological Elements. Some erosion and stream siltation could occur as a result of clearing and grading although good engineering practices will be carried out to reduce the possibility. Temporary increases in the turbidity of Avery Creek and along the shoreline of the Des Moines River could reduce the productivity of photosynthetic organisms; however, the effect should not be significantly different from that of runoff from cultivated land.

5.0121 The construction of the intake structure also could briefly increase slightly the turbidity of the Des Moines River near the Station Site.

5.013 Air Quality. There will be some dust generated from construction activities. Combustion gases will be discharged from construction vehicles and machinery working on the site.

5.014 Social and Economic Impacts. Two families and one single resident totaling 11 persons will be relocated from the Ottumwa Station Site. Based on 1975 dollars, an annual crop value of $125,830 will be lost because of the conversion of the site from agricultural purposes to industrial use. There will be increased traffic in the plant site area during the construction period.

5.02 Impacts of Generating Station Operation.

5.021 Air Quality. The level of certain air pollutants is expected to increase when the Ottumwa Station is in operation. The concentrations of sulfur oxides, nitrogen dioxide, ozone, and particulate matter would increase. Emission of pollutants from the station will be minimized by the burning of low-sulfur content coal and the use of a tall stack to enhance the dilution of emission gases. All air quality standards will be met.

5.022 Water Quality and Biological Elements. Wastewater discharge will be monitored in accordance with applicable regulations and there should be little adverse impact on the water quality of the Des Moines River.

5.0221 Water withdrawn from the Des Moines River for cooling water make-up and other uses (maximum rate of 20 cfs) will constitute a consumption use and organisms present in the water will be lost from the river ecosystem. The effects of entrainment should be minimal because the volume make-up water normally will not exceed 17.2 cfs, about 5 per cent of the minimum regulated river flow of 300 cfs.

5.0222 Some fish may become impinged on intake screens and injured or killed, but efforts to alleviate these effects would be made by careful design, and placement of the intake structure together with a flow approach velocity to the intake screens of only 1.0 feet per second or less.

5.0223 Economic and Social Impacts. No adverse economic impacts are expected from the operation of the Ottumwa Generating Station. The presence of the tall stack and the station facility will detract from the aesthetic appeal of the area. Noise from the station operations would be largely dissipated at the site boundary, but may add slightly to the ambient level of the surrounding area.

VI ALTERNATIVES TO THE PROPOSED PROJECT

6.01 No Action. One alternative would be not to construct and operate the Ottumwa Generating Station. Without the 727 MW station, ISU and the other owners would be unable to meet projected energy demands in their service areas (see Section 1.02). Electric power deficiencies will occur in the latter part of this decade without the Ottumwa Station.

6.011 Iowa utilities are required by law to provide adequate service to their customers. The generating capacity of a utility's plant, supplemented by the electric power regularly available from other sources, must be sufficiently large to meet all normal demands for service and provide a reasonable reserve for emergencies[1].

6.012 Assuming that restricting service would be an alternative to the Ottumwa Station, it is evident that without increased generating capabilities the operations and growth of industrial, commercial and household customers would have to be curtailed. An evaluation of the social and economic effects that would result is beyond the scope of this study.

6.013 Because of legal requirements and the adverse consequences of restricting the use of electric energy, the alternative of not providing increased generating capacity; i.e. construction and operation of the Ottumwa Generating Station, is not feasible.

6.02 Purchase Power. It is unlikely that significant amounts of power will be available for long-term purchase. The owners of the Ottumwa Generating Station are members of the Mid-Continent Area Power Pool (MAPP); however, MAPP only provides a mechanism for supplying power primarily during emergencies and for frequency stability. Large blocks of power cannot be obtained consistently for extended periods.

6.021 It is not practical to purchase power in other parts of the country and transmit the electric energy to Iowa. Transmission losses vary directly with distance and with the square of the amount of power transmitted. Considerable power loss would occur in transmitting electric power over long distances, and the cost would be significantly more than the cost of locally produced power.

6.022 The purchase of power as an alternative to the Ottumwa Station is not practical.

6.03 Alternate Methods of Generation

6.031 Combustion Turbines. Combustion turbines are useful in generating power during peak loads and for other short-term applications. The units are not suitable for continuous operation, they are inefficient, and they require frequent maintenance. In addition, combustion turbines burn gas or fuel oil, both of which are in short supply and are becoming more expensive.

6.0311 Combustion turbines would not be suitable to satisfy long-term base load energy requirements.

6.032 Hydroelectric Generation. There are no suitable sites for hydroelectric power generating stations that would meet the base load requirements of ISU and the other utility companies involved.

6.0321 Pumped storage projects also would not be feasible because of the lack of suitable sites for plants to meet base load requirements.

6.04 Alternate Fossil Fuels

6.041 Natural Gas. Natural gas is a relatively clean burning fuel that could be considered as an alternative to coal. Unfortunately, there is a national shortage of natural gas, and about 7,010,000 cubic feet an hour of gas would be required to operate the Ottumwa Station at full load. There are no suppliers that would contract to provide that quantity of natural gas. Most suppliers are refusing to sell gas to new large nonresidential customers, and in many instances will not increase deliveries to present consumers.

6.0411 Because of the shortage of natural gas and its general unavailability to new large industrial users, it was rejected as an alternative to coal as fuel.

6.042 Synthetic Gas Fuel. Although processes for producing synthetic gas are being developed, the technology is not presently available to produce an adequate fuel supply for the Ottumwa plant.

6.043 Fuel Oil. The supply of fuel oil is limited and the cost would be at least twice as much per Btu produced as compared to low-sulfur coal.

6.0431 Furthermore, Federal Energy Administration will not permit the use of oil as fuel for steam generating stations.

6.044 Iowa Coal. One of the first alternatives considered was the obvious one of Iowa coal. The use of an Iowa supply would minimize transportation costs and reliability problems and has the further advantage of providing employment and economic activity to the State of Iowa.

6.0441 The Iowa Coal Project, funded by the State of Iowa and carried out at Iowa State University, has started a detailed and extensive study of Iowa coal reserves, mining methods, and sulfur removal techniques. Reserves of some 6 to 7 billion tons have been identified, indicating that a large amount of Iowa coal could be mined. This coal generally runs 10,000 to 11,000 Btu per pound with a sulfur content of 3 per cent to 7 per cent. Approximately half of the sulfur can be removed by a washing process which would leave sulfur in the 1-1/2 per cent to 4 per cent range. According to the EPA New Source Performance Standards the maximum sulfur content for 10,000 Btu coal is 0.6 per cent. Therefore, the use of Iowa coal would require the installation of a flue gas scrubber at an additional capital cost of approximately $40,000,000 and additional operating cost of $.55 per million Btu.

6.0442 Although plentiful, Iowa coal lies in seams of 2 feet to 4 feet and at depths of over 100 feet. These seams are difficult and expensive to mine by either strip or underground processes. AMAX Coal Co. has made an extensive study of mining in Iowa and estimates the cost of such coal at $25 per ton at the mine. Costs of Iowa coal summarize as follows:

Cost of coal at mine	$25.00
Transportation to OGS	1.50
	$26.50/ton
For 10,000 Btu coal this is equal to	$ 1.33/MM Btu
Scrubber operating costs	.55/MM Btu
Total Fuel Costs:	$ 1.88/MM Btu

6.0443 Only about 1,000,000 tons per year of Iowa coal are presently mined which would not be adequate to operate the Ottumwa Generating Station[2]. Initially the Ottumwa Station will use about 2,200,000 tons per year of coal.

6.0444 Because of economic considerations, an inadequate supply presently available, and high sulfur content, Iowa coal is not a viable alternative as a fuel source for Ottumwa Station.

6.045 Missouri, Illinois, Kentucky, and Other Midwestern Coal. In exploring other Midwestern coal supply possibilities, it was found that no Midwestern supply exists which will meet the New Source Performance Standards without the use of a flue gas scrubber.

6.0451 Although some economies of scale exist in the larger mines in Illinois and Kentucky, it would take a commitment of new capital and in most cases the opening of a new mine to meet the 2,200,000 ton per year requirement for OGS. The quoted costs of strip mined coal throughout this Midwestern region is in the \$20 to \$25 range with underground mined coal substantially higher. Estimated costs for this fuel supply are:

Cost of coal at the mine	$20.00
Transportation to OGS	3.00
	$23.00
For 10,000 Btu coal this is equal to	$ 1.15/MM Btu
Scrubber Operating Costs	.55/MM Btu
Total Fuel Costs:	$ 1.70/MM Btu

6.046 Western Coal. An investigation of low sulfur Western coal sources revealed that coal quality, availability, and prices varied widely. Distances in the West are great, leading to considerable variation in freight costs.

6.0461 Initially it appeared that the lowest cost source of low sulfur, EPA compliance fuel (under 0.5 per cent sulfur) would be the Powder River Basin near Gillette in northwestern Wyoming. Mining conditions in that area lead to the lowest cost production in the United States. The coal seams there are 70 feet to 100 feet thick and lie under as little as 30 feet of overburden. Coal was being sold from the AMAX mine in 1972 for under \$2.00/ton at the mine.

6.0462 By late 1973, however, environmental interests had effectively stopped mine development in that area and there was no certainty that coal could be delivered to meet the 1980 time schedule for OGS. Therefore, while maintaining contact with the oil interests which held coal reserve leases in the Powder River Basin, the search was broadened to other supplies of Western coal.

6.0463 Existing mines or proposed mines in other parts of Wyoming and Colorado were found which were not subject to the environmental restrictions of the Powder River Basin and which could guarantee delivery of coal to meet OGS requirements. This coal, however, came from underground or deep open pit mines which cannot match the low mining costs at Powder River. Thus, early cost estimates and the decision to concentrate on Western coal were based on higher cost estimates than those which will apply to Powder River coal.

6.0464 Recently, rapid developments have occurred in Western coal mining. The U.S. Supreme Court has lifted the injunction preventing further mine development and a decision on the requirement of a six state environmental impact statement will be necessary before mining or railroad construction can begin. All indications are that this decision will be favorable to the mining interests. As a result mines are once again under construction and coal supply contracts are being offered.

6.0465 The following cost quoted is a worst case example and is a major reason for concentration on Western coal as the best alternative fuel source for OGS.

Cost of coal at mine	$14.00
Transporation to OGS	10.00
	$24.00
For 8,000 Btu coal this is equal to	$ 1.50/MM Btu
Scrubber operation costs	--
Total Fuel Costs:	$ 1.50/MM Btu

6.05 Nuclear Fuel Source. Since from 8 to 10 years are required to construct and place in operation a nuclear power station, it would not be possible to have the necessary generating capability by 1981.

6.051 Only about 4 years will be required to place the Ottumwa Generating Station in operation.

REFERENCES

1. Code of Iowa, Sections 490.8 and 490A.26. (1973).

2. Iowa Geological Survey, Resource Development, Land- and Water-Use Management, Eleven-County Region, South-Central Iowa, Iowa City, Iowa (1973).

6.06 Alternate Modes of Fuel Transportation

6.061 Barge Transportation. Transportation of the plant's coal fuel will be by rail; however, other methods were evaluated. One alternative method considered was to transport the coal by barge on the Des Moines River. This method was found to be impractical. The Des Moines River is not large enough to maintain its flow within certain limits of channel depth. Presently, there are no lock and dam installations to maintain channel depth and produce an artificially regulated, navigable Des Moines River.

6.062 Coal Slurry Pipeline. One possible method for transporting coal to the site is by pumping crushed coal with slurry water through an underground pipeline from the coal mine to the power plant. There are no coal slurry pipelines in the vicinity of the proposed generating station nor are there plans to construct any.

6.07 Alternate Plant Sites

6.071 Introduction. In studies conducted by Black & Veatch and ISU, a number of sites were evaluated as to their suitability for locating and operating a steam generating station.

6.072 Candidate Site Selection

6.0721 Candidate sites were screened and selected by meeting the following considerations.

6.0722 Service area. The candidate sites should be in close proximity to the ISU service area.

6.0723 Land area and use. A minimum of 600 acres of land will be required for the project. Current and projected land use practices must be compatible with the construction and operation of a 727 MW unit installation.

6.0724 Water supply. A reliable source of water must be available for use. The source should be capable of supplying an estimated 20 cfs of water for continuous cooling tower makeup and other plant uses.

6.0725 Transportation access. All candidate sites must have close proximity to transportation networks--railroad, highway, and/or barge; or be capable of their development for shipment of materials and use by construction workers and personnel.

6.0726 Transmission access. The site should be located near existing or proposed transmission lines and substations.

6.0727 Population. Those sites that are located away from population areas or centers will be given priority.

6.0728 Electric load. The sites should be located near the load center.

6.0729 Flood protection. Sites having adequate flood protection or the potential for development at a reasonable cost were considered.

6.07210 Environmentally sensitive areas. Candidate sites will be screened for possible interference with the following.

a. Any local, state or federal park and reserve; rec reational and other public use areas.

b. Archaeological, historical, or cultural landmarks.

c. Rare or endangered fauna or flora species including their habitats and breeding and/or nesting areas.

6.073 Site Selection Process

6.0731 Investigative studies were performed and the number of sites considered was narrowed to four--the Bridgeport site at Eddyville, the Burlington site and two sites near Chillicothe, (Sites F and G). The other sites were found to be unsuitable. ISU's service region and the already existing Bridgeport and Burlington plants and the area for Sites G and F around Chillicothe are shown in Figure 1-2 (Section 1). The arrangement of Sites F and G are shown in Figure 6-1.

6.0732 Criteria for the final selection of the site were as follows.

6.0733 Evaluations should include a unit of approximately 350 MW gross and a unit of 600 MW gross.

6.0734 Facilities should be based on the use of a low sulfur western coal as well as a high sulfur coal.

6.0735 The site should provide space for storage of 90 days supply of coal and for 25 years ash storage, assuming no gas scrubbing.

6.0736 Siting considerations should take into account the existing plant facilities at Bridgeport and Burlington and the effect that new facilities would have on any requirements for retrofitting the existing equipment to meet pollution requirements.

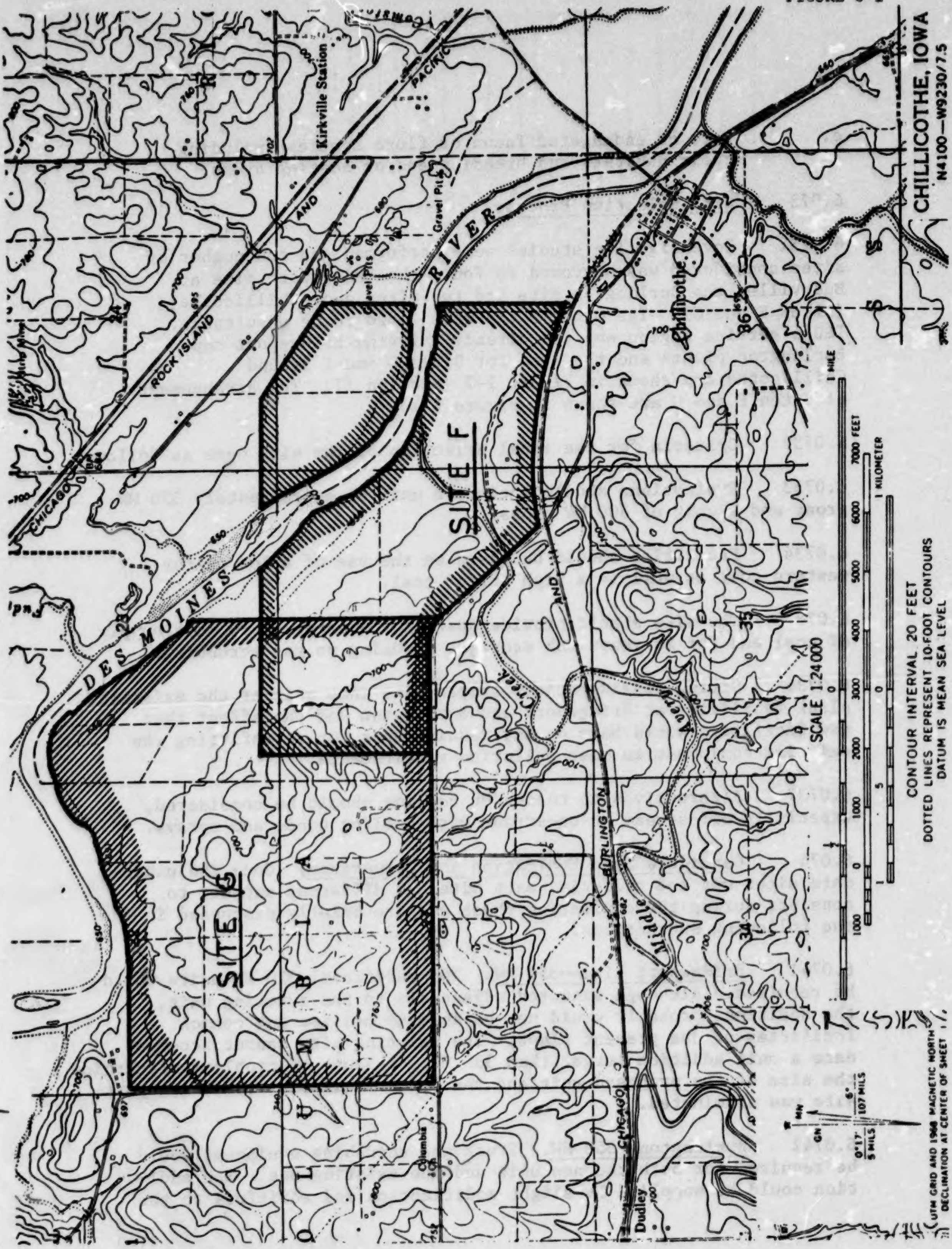
6.0737 Alternatives to condenser cooling should be considered, especially off-stream or on-stream with cooling ponds and sprays.

6.074 Candidate Site Evaluation and Comparison. Once the candidate sites met the criteria, each site had different aspects to consider during the evaluation phase and are briefly discussed in the following subsections.

6.0741 Bridgeport site--350 MW. Two additional 350 MW units would be required. Although situated adjacently to the existing unit, the additions probably would not be able to utilize any common facilities of the present plant. The existing site cannot accommodate a unit addition larger than 350 MW. Because of problems concerning the size of the proposed unit and the space available, the Bridgeport site was eliminated.

6.0742 Burlington--350 MW. Stack gas scrubbing equipment would be required for both the new unit and the existing one. The addition could be supplied by slight modification and additions to the

FIGURE 6-1


CHILLICOTHE, IOWA
N4100—W9230/7.5
SITE F
SITE G
DES MOINES
RIVER
CHICAGO
ROCK ISLAND
AND
PACIFIC
Kirkville Station
Gravel Pits
Chillicothe
BURLINGTON
AND
CHICAGO
Avery
Creek
Middle
Dudley
Columbia
SCALE 1:24 000
1 MILE
7000 FEET
1 KILOMETER
CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL
UTM GRID AND 1968 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

existing coal handling system. Utilization of a common control room facility for both units would be possible. Canal type condenser cooling would not be possible due to the low terrain and extensive earth-fill required. This site was eliminated because of the additional costs involved with the scrubbing equipment for both the new and existing units and because of the modifications and additions that would be necessary for the coal handling system.

6.0743 Burlington--600 MW. There is not sufficient space on the site for all the coal, ash and stack scrubbing facilities which would be necessary. Because of the large size, it would not be possible to have the unit located as an adjoining addition to the existing unit. This site was considered unacceptable for these reasons.

6.0744 Site F--600 MW. The layout has been developed on unit train type of coal delivery. Space consideration would be involved with stack gas scrubbing equipment; however, elimination of this equipment would be possible by use of a hot electrostatic precipitator and by dispersion by a tall stack. With the use of a low sulfur western coal, it would be possible to satisfy emission standards.

6.0745 Site G--600 MW. Requirements for scrubbing and coal storage have been included, assuming coal arrival by unit train. Arrangement would be modified if stack gas scrubbing was not required. Considerations for Sites F and G were basically the same with the exception of the land acquisition and the site arrangement.

6.0746 Table 6-1 is an evaluation and comparison table that lists the siting considerations for the alternate plant sites. Land acquisition, site accessibility and versatility, substation requirements, emission control, coal handling, circulating water, estimated cost, and any archaeological, historical, or cultural landmark were assessed for each site.

6.0747 In addition, sites were screened for population centers within a 5-mile radius. Figures 6-2, 6-3, and 6-4 show the population centers around Burlington, Bridgeport, and the Chillicothe sites. Table 6-2 lists the towns, the county in which they are located, and the population estimates if available.

6.075 Conclusion

6.0751 The site chosen for the construction of the Ottumwa Generating Station is adjacent to the Des Moines River on the north side and to the town of Chillicothe on the southeast edge in Wapello County, the Columbia-Cass Township. The current site constitutes

Table 6-1

SITE COMPARISON TABLE

Capacity Location Fuel (New Unit) Fuel (Existing Unit)	350 MW Bridgeport Wyoming Coal	350 MW Bridgeport Illinois Coal	350 MW Burlington Wyoming Coal Illinois Coal	350 MW Burlington Wyoming Coal Wyoming Coal	350 MW Burlington Illinois Coal Illinois Coal	600 MW Burlington Wyoming Coal Illinois Coal	600 MW Burlington Wyoming Coal Wyoming Coal	600 MW Burlington Illinois Coal Illinois Coal	600 MW Sites F & G Wyoming Coal	600 MW Sites F & G Illinois Coal
Siting Considerations										
Land Acquisition	Substation + Ash Ponds - Approx. 250 Acres	Substation + Ash Ponds - Approx. 250 Acres	Ash Pond - 200 Acres	Ash Pond - 200 Acres	Ash Pond - 200 Acres	Ash Pond - 200 Acres	Ash Pond - 200 Acres	Ash Pond - 200 Acres	600 Acres	600 Acres
Site Accessibilities Rail Highway	3-1/2 mile Spur Good	3-1/2 mile Spur Good	On Site - Extensions Good	On Site - Extensions Good	On Site - Extensions Good	Extend for Unit Train Good	Extend for Unit Train Good	Enlarge for Unit Train Good	-- Minimum Spur Good	-- Minimum Spur Good
Site Versatility	Poor	Poor	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good
Substation Requirements	161 kV	161 kV	345 kV	345 kV	345 kV	345 kV	345 kV	345 kV	345 kV	345 kV
Emission Control (New Unit) Particulate SO_2	Hot Gas ESP --	Hot Gas ESP Scrubber	Hot Gas ESP --	Hot Gas ESP --	Cold Gas ESP Scrubber	Hot Gas ESP --	Hot Gas ESP --	Cold Gas ESP Scrubber	Hot Gas ESP --	Cold Gas ESP Scrubber
Emission Control (Existing Unit) Particulate SO_2	-- --	-- --	-- Scrubber	Gas Conditioning --	-- Scrubber	-- Scrubber	Gas Conditioning --	-- Scrubber	-- --	-- --
Coal Handling	New System	New System	New System	Extend Existing	Extend Existing	New System	Extend Existing or New System	Extend Existing or New System	New System	New System
Circulating Water	C. Towers	C. Towers	C. Towers or possibly once-through	C. Towers or possibly once-through	C. Towers or possibly once-through	C. Towers	C. Towers	C. Towers	C. Towers	C. Towers
Estimated Cost of Equipment, Materials, and Construction, $/kW	306	366	344	300	397	302	280	362	281	341
Population Centers within 5 mile radius	3	3	8	8	8	8	8	8	6*	6*
Archaeological, Historical, or Cultural Landmarks	0	0	0	0	0	0	0	0	0	0

Table 6-2[a]

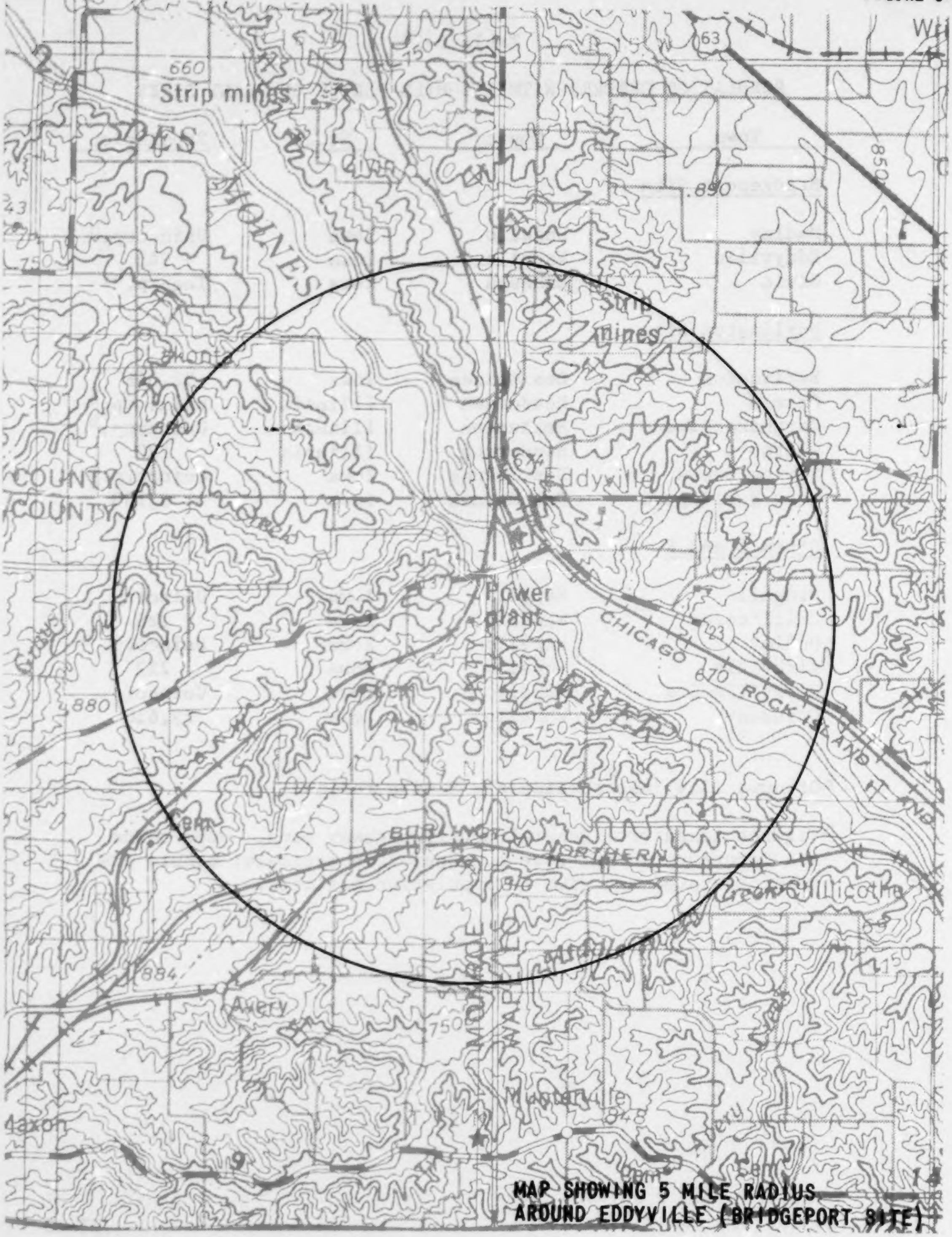
POPULATION CENTERS WITHIN 5-MILE RADIUS OF PLANT SITES

Town	County	State	Population
Bridgeport Site			
Dudley	Wapello	Iowa	Unincorp.[b]
Eddyville	Wapello	Iowa	945
Givin	Mahaska	Iowa	Incorp.[b]
Burlington Site			
Burlington	Des Moines	Iowa	32,366
Carman	Henderson	Illinois	Unincorp.[b]
Carthage Lake	Henderson	Illinois	Unincorp.[b]
Gulfport	Henderson	Illinois	220
Spring Grove	Des Moines	Iowa	Unincorp.[b]
West Burlington	Des Moines	Iowa	3,139
Sites G and F			
Bidwell	Wapello	Iowa	Unincorp.
Chillicothe	Wapello	Iowa	126
Dudley	Wapello	Iowa	Unincorp.
Kirkville	Wapello	Iowa	222
Kirkville Sta.	Wapello	Iowa	Unincorp.
Ottumwa*	Wapello	Iowa	29,610

[a] Ottumwa lies just outside the 5 mile radius.

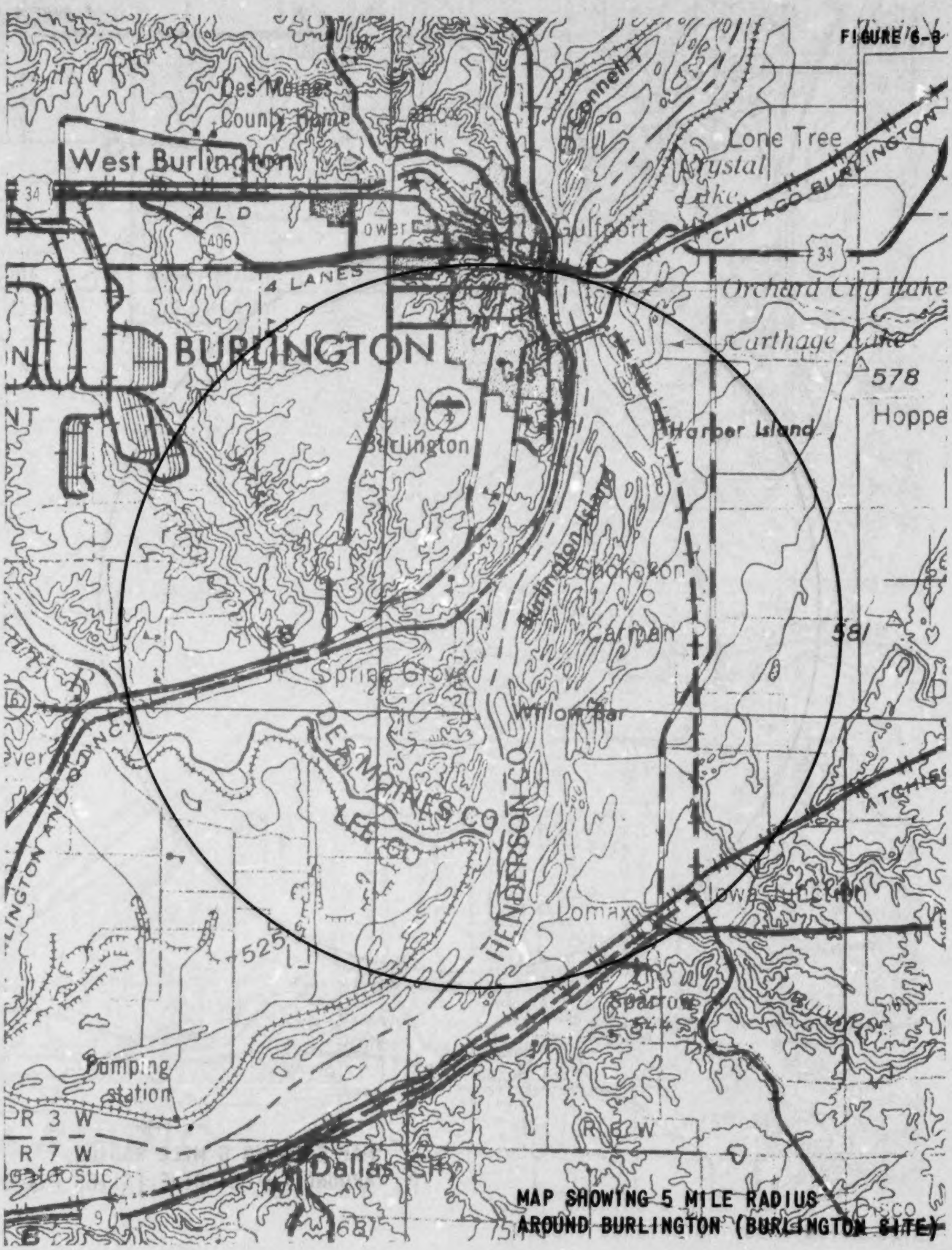
[b] Figures taken from general county highway maps. Some towns are incorporated but give no population estimate; others are unincorporated and give no population estimate.

FIGURE 6-2



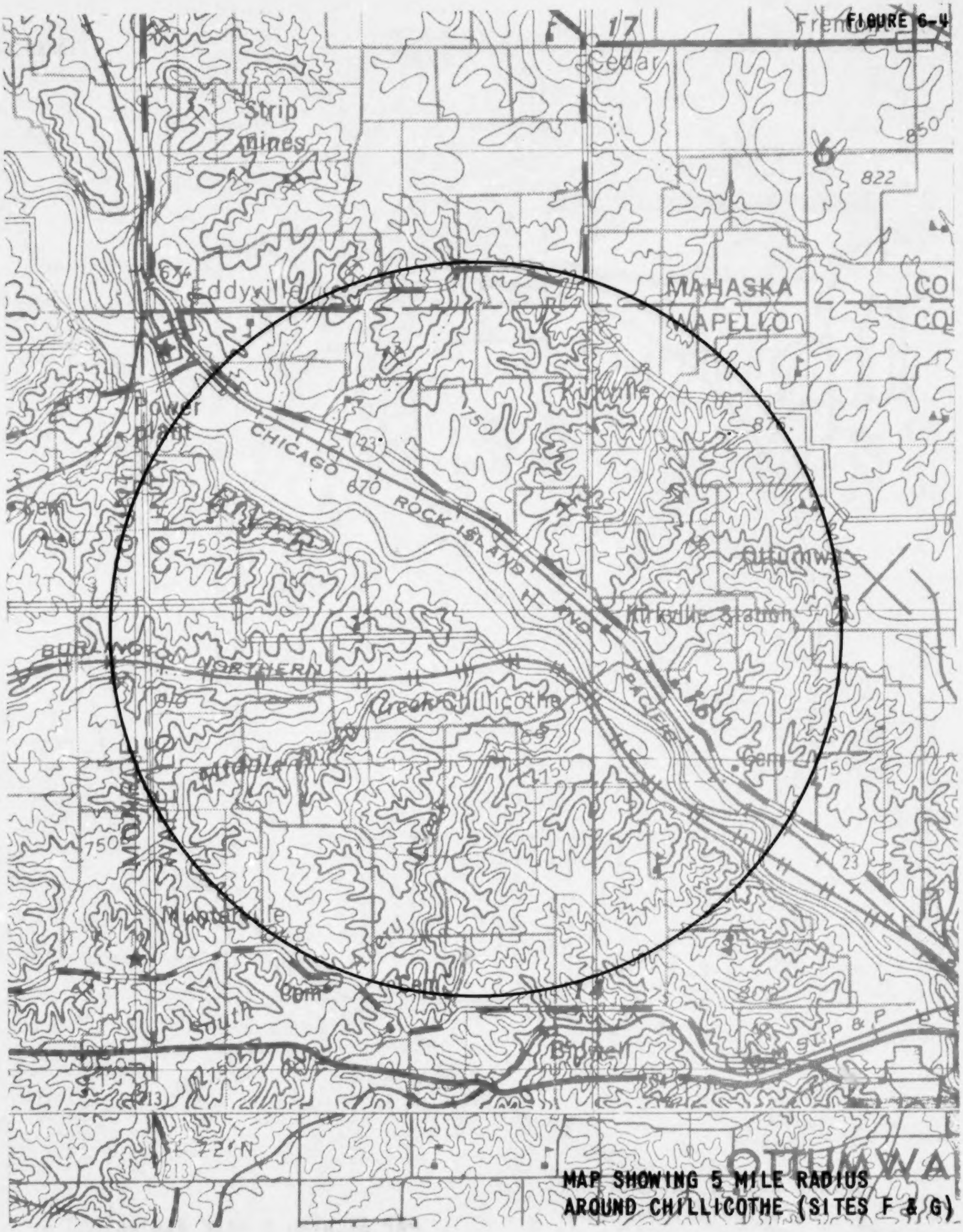
MAP SHOWING 5 MILE RADIUS AROUND EDDYVILLE (BRIDGEPORT SITE)

FIGURE 6-8



MAP SHOWING 5 MILE RADIUS AROUND BURLINGTON (BURLINGTON SITE)

FIGURE 6-4



MAP SHOWING 5 MILE RADIUS AROUND CHILLICOTHE (SITES F & G) the former Site F with the exclusion of the tract of land just north of the river.

6.0752 A 727 MW unit will be constructed instead of the proposed 350 MW and 600 MW units because it will be more efficient and economical to operate. The site is suitable for accommodating a unit of this size.

6.0753 Service area. The site is located in the Iowa Southern Utilities' service area.

6.0754 Land area and use. The plant site will consist of approximately 795 acres. The majority of the land on the site and surrounding areas is currently used for agricultural purposes. The site will be converted from agricultural to commercial use.

6.0755 Water supply. Water needed for station makeup will be obtained from the Des Moines River.

6.0756 Transportation access. The site chosen is located on a main line of the Burlington-Northern Railroad, which gives it direct access to western coal mines.

6.0757 There is access to three county maintained roads (21, 27, and 67) within the 5-mile radius of Chillicothe; State Highway 23, on the north side of the river, runs southeast from Eddyville to Ottumwa, with a link at Kirksville Station to Chillicothe.

6.0758 Population. The selected site is located in a low density population area.

6.0759 Air navigation interference. Since the height of the stack will be over 200 feet, a determination as to the possible hazard to air navigation will be needed from the FAA. No interference to air navigation is anticipated.

6.07510 Electric load. The generating station will be centrally located with respect to the load, and therefore, the transmission costs will be minimal.

6.07511 Environmentally sensitive areas. The proposed plant site is not near any park, animal refuge, wetlands, or historical site.

6.07512 Emissions. The emissions from the facility will not have an offensive odor and, due to the low concentrations, will not be dangerous. Low sulfur coal will be used as fuel and all emission standards will be met.

6.07513 Final selection. The location selected was the most suitable of the potential sites considered. Deciding factors included the easy transportation access to coal supply; the abundant water supply due to the site's location on the Des Moines River; and the central location of the site in relation to the load and the minimal transmission costs.

6.08 Transmission System Selection

6.081 Transmission System Planning.

6.0811 Introduction. In August 1975, the Ottumwa Generating Station (OGS) owners began studying the transmission system which would be required to transmit OGS generation to the load and meet the other requirements of a transmission system. This study dealt primarily with system operation, economic, and reliability aspects. Many transmission alternatives were studied including systems which were totally 161 kV, systems which were totally 345 kV, and several combination 345 kV and 161 kV systems, one of which was chosen as the final OGS area transmission plan.

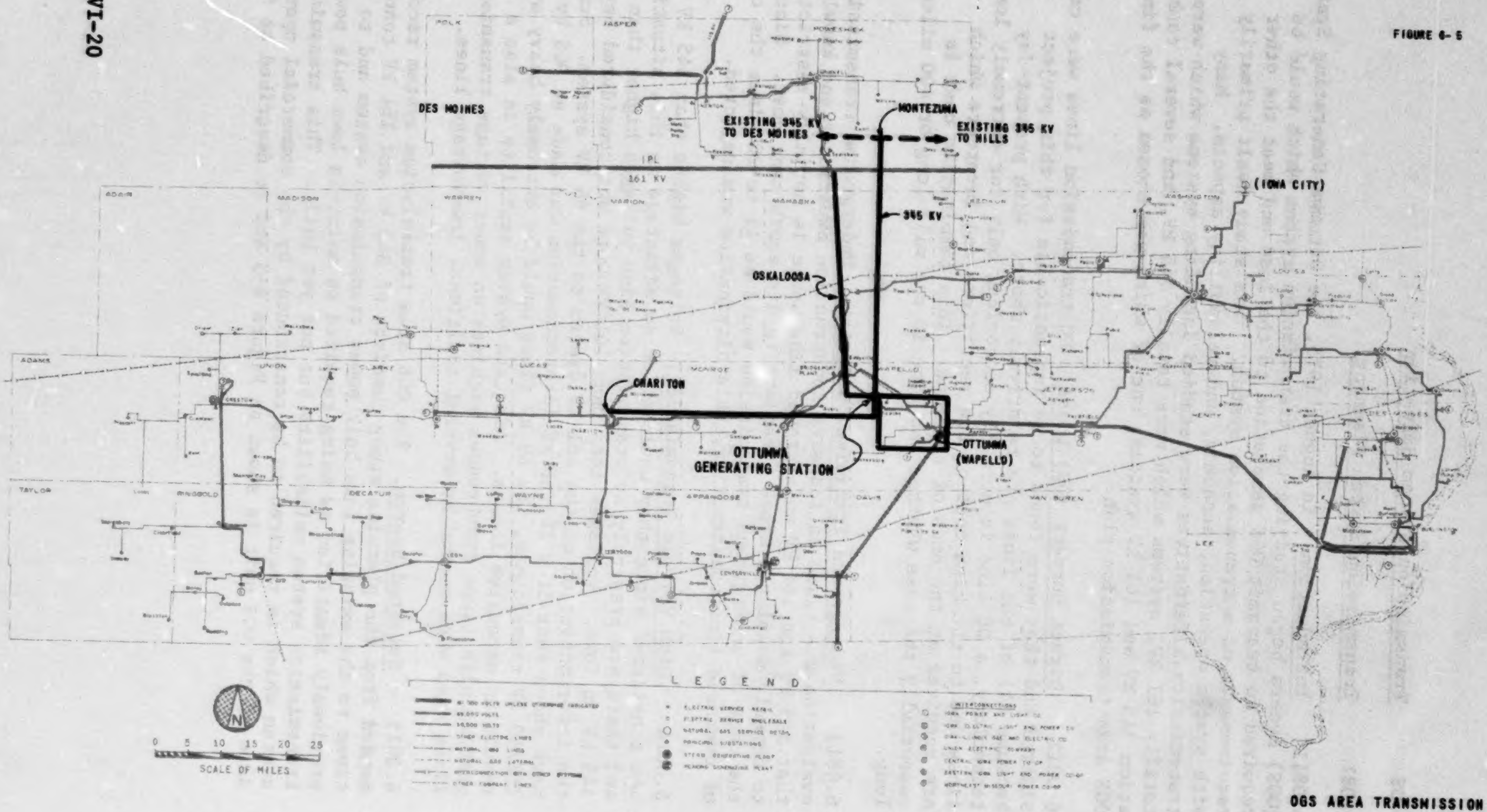
6.0812 Direct Current (DC) Lines. DC transmission lines were considered and they were found to be impracticable for this project because all of the lines are relatively short. With present-day technology, a DC line is normally economical only for extremely long lines due to the high cost of the rectifiers and inverters which are required at the ends of the line. This termination cost is essentially the same whether the line is one mile long or 400 miles long.

6.0813 Underground Transmission System. Underground transmission evaluation was based on industry construction experience and knowledge that 345 kV and 161 kV underground line usage is normally restricted to densely populated urban areas due to its exorbitant cost. Since the cost of underground transmission would be 15 to 20 times the cost of overhead line construction, this alternative was rejected.

6.0814 High Voltage Transmission. Voltages higher than 345 kV were not considered since they would offer no advantage in this situation and there are presently no transmission line voltages higher than 345 kV in Iowa. Voltages less than 161 kV were not considered beyond the interconnection of the 161 kV system to the 69 kV system. Studies have shown that if a 161/69 kV interconnection was made at OGS by a 161/69 kV transformer, the 69 kV flows would be extremely heavy and result in extensive losses. Adequate system stability is also a problem with large synchronous machines on lower voltage transmission lines even when served by several additional low-voltage lines.

6.0815 Selected System. The OGS area transmission system recommended from the planning study consists of 345 kV and 161 kV connections to the existing Iowa bulk power transmission system and to lines previously identified as being required to maintain Iowa bulk power transmission system reliability but not yet built. This transmission system which is required to be constructed by the commercial operation date of the OGS unit is shown on Figure 6-5 and is described as follows.

FIGURE 6-5



OGS AREA TRANSMISSION

6.08151 OGS-Oskaloosa-Poweshiek 161 kV line. This line will connect OGS to an existing 161 kV line between Des Moines and Iowa City. The Oskaloosa-Poweshiek 161 kV portion of this line will be built in 1977 and 1978 to provide transmission support to the Oskaloosa area.

6.08152 OGS-Chariton 161 kV line. The OGS-Chariton 161 kV line will be built in 1980 to provide transmission support to the Chariton area.

6.08153 OGS-Ottumwa (Wapello County Substation) 161 kV line around the north side of Ottumwa to complete the 161 kV tie between the Ottumwa area 161 kV and the Des Moines-Iowa City 161 kV line. The complete tie will be important for improved reliability of the area load and for general improvement of the 161 kV grid in southeast Iowa.

6.08154 OGS-Ottumwa (Wapello County Substation) 161 kV line around the south side of Ottumwa. Two 161 kV lines from OGS to Ottumwa are needed because of heavy power flows in this segment and to provide OGS unit stability.

6.08155 OGS-Montezuma 345 kV line. This 345 kV line will transmit power from OGS to the existing Iowa 345 kV system and help provide system stability.

6.08156 As described, some of the 161 kV lines in the OGS area are required to provide system reliability to loads and have been planned as system additions prior to the planning and final location of OGS. These lines, which are required whether OGS exists or not, are the Oskaloosa-Poweshiek 161 kV line, a 161 kV line to Chariton (OGS-Chariton), and a complete circuit from Oskaloosa to Ottumwa (Oskaloosa-OGS-Wapello County 161 kV line). When the final planning and location of OGS was established, these circuits were adequately sized and routed through the OGS site to help export OGS power as well as provide for previously identified system needs. If this combination of service had not been selected for these lines, lines in addition to those presently planned for the OGS area would be required.

6.08157 The 345 kV line from OGS to Montezuma and the second (southern) circuit from OGS to Wapello County are specifically needed for OGS to provide adequate outlet transmission and for generating unit stability.

6.08158 The OGS transmission system recommended will provide the most reliability to the area loads and the OGS unit for the least circuit miles of line. It also is compatible with the long-range transmission requirements for the State of Iowa and the Mid-Continent Area Power Pool (MAPP). When this particular planning stage of study was completed, the system had been completely evaluated from the following standpoints: system reliability and operation, system stability, economics, and coordination with future requirements. The system design was approved by the Design Review Committee of the Mid-Continent Area Reliability Coordination Agreement (MARCA) composed of representatives of Omaha Public Power District, Basin Electric Power Cooperative, Cooperative Power Association, Northern States Power Company, Iowa Power and Light Company, Western Area Power Administration (Department of Energy), and Iowa Southern Utilities Company.

6.082 Transmission Routing and Land Use. After the transmission system is selected, an exact route for each new line segment in the system must be determined. Land use and environmental compatibility, as well as economics of construction and operation, are major considerations in the selection of alternate routes. These factors will be evaluated and compared to determine the best specific route for each transmission line segment. To initiate the legal process associated with line routing, a public informational meeting date is requested from the Iowa Commerce Commission. After the Iowa Commerce Commission has determined the date, time, and place for the informational meeting, the Company then notifies all landowners, interested parties, and jurisdictional agencies who might be affected by any of the alternate routes. The informational meeting is held under the direction of the Iowa Commerce Commission. At this meeting, the Company presents information to the attendees (landowners and parties of interest, etc.) on the need for the line, the type of line that is being proposed and discusses some of the routes which have been considered. Landowners and others have the opportunity to ask questions and to make any suggestions that they feel appropriate. The Company is required to provide the best answers available at that time to any questions which might be asked.

6.0821 Following this informational meeting, Iowa Southern evaluates the alternate routes considering all information available, including that gained at the meeting. If a new, viable alternate route has been suggested, this alternate will also be evaluated.

6.0822 General guidelines which are followed in transmission routing are as follows.

6.08221 Transmission line rights-of-way will avoid cemeteries, quarries, airports and air landing strip facilities, monuments, parks, recreational areas, environmentally sensitive areas, historic sites, houses and buildings.

6.08222 Special efforts will be made to route lines along and parallel to the slope of hills rather than ridge line construction, to minimize line visibility. Developed areas and areas of potential development will be avoided where possible.

6.08223 Where possible and subject to Iowa law, which requires that lines be constructed near and parallel to railway right-of-way or along land division lines, the right-of-way will be confined to areas devoted to timberland and pastureland use. Intensively cultivated areas will be avoided by the location of structures in fences or in wasteland wherever possible and reasonable to do so.

6.08224 Densely populated areas will be avoided.

6.08225 Specific items used to evaluate feasible routes and to determine the most desirable routes are:

a. The length of the line required by each alternate.

b. The land use by category (intensive cropland, rotation cropland, pasture-hay land, woodland-wasteland and other).

c. The structures which are located in each of the land use categories are tabulated, and the number of structures that are in cross fences, the number that are along fences and along roads are compared for the alternate routes.

d. Because of line-building proximity, legal restrictions in Iowa and electrical safety code requirements, a tabulation is made of the number of buildings which would be near the transmission line on each alternate route.

e. The total cost of each alternate route and the power loss associated with each alternative is evaluated.

f. Any potential inductive interference problems with other lines are considered.

6.08226 After all this information has been assembled, the Company selects the route which it determines is the most reasonable route. The basic premise is to cause the least impact on the fewest possible people. The final route, however, is determined by the Iowa Commerce Commission after a franchise hearing.

6.083 Right-of-Way Easements. After the proposed route is selected, aerial photography is used to obtain plan and profile sheets for the proposed line. The engineering work of actually locating the structures along the proposed route on these plan and profile sheets is begun. After each structure has been located on the plan and profile sheets and after easements with property descriptions have been prepared, the landowners who will have the line on their property are then contacted by the Company. At this time the Company is prepared to explain where they would like to place structures on each property and is prepared to make an offer to the property owner as compensation for the easement.

6.0831 Typically, easements are required for a 100-foot wide right-of-way strip on 161 kV and 150 feet wide on 345 kV. This easement grants the Company the right to reasonable ingress and egress to survey, build, operate, and maintain the transmission line. The Company is also responsible for any damage to the property which is encountered during and up to 5 years after the construction of the transmission line or during any subsequent maintenance to the transmission line. Farmers can and do continue to use the land underneath the transmission line for regular crop production except where the poles actually sit.

6.0832 Maintenance rights include the right to go on the land for line inspection and to keep it free from trees, brush, or structures which might interfere with the safe operation of the line. The landowner retains all other rights and privileges of ownership. He may cultivate it, use it for pasture, or build fences, for example. Damage settlements are made each time the property is entered and there is any damage to crops, fences, or property.

6.084 Franchise Hearing. After an easement agreement has been reached with as many landowners as possible, a franchise hearing is requested by the Company. The purpose of the hearing is to consider the proposed route to apply for a franchise and the right of eminent domain on all parcels where a voluntary easement has not been obtained. The Iowa Commerce Commission determines the date, time, and location of the franchise hearing. Once again, all landowners, affected parties, and jurisdictional agencies are notified of this hearing.

6.0841 At the franchise hearing, all facts concerning the need for the line, the evaluation of alternate routes, and the design of the line as defined in Section 478.3 of the Iowa Code are considered. Any objectors to the line and their attorneys have the right to make a presentation and to question Company witnesses.

6.0842 Following the franchise hearing, the Iowa Commerce Commission then has the authority to grant the franchise and right of eminent domain, modify the petition, or to deny the petition. If the franchise petition is denied, a new route must be selected and the process repeated, starting with the informational meetings. If the franchise petition is granted with the right of eminent domain, the exact structure locations are then staked on the properties where voluntary easements have not been obtained. A local compensation commission will then determine the easement compensation to be awarded these property owners.

6.0843 The compensation commission, composed of six property value experts, is selected by a District Court Judge to examine each structure location and determine how much compensation is due each landowner. After this award, the quantity may be appealed by either the landowner or the Company, but after the compensation commission award has been determined, the Company can place the awarded amount of money with the County Sheriff and then the Company can start construction on the project. The landowner has the right to obtain his awarded money from the Sheriff or leave it there as he prefers.

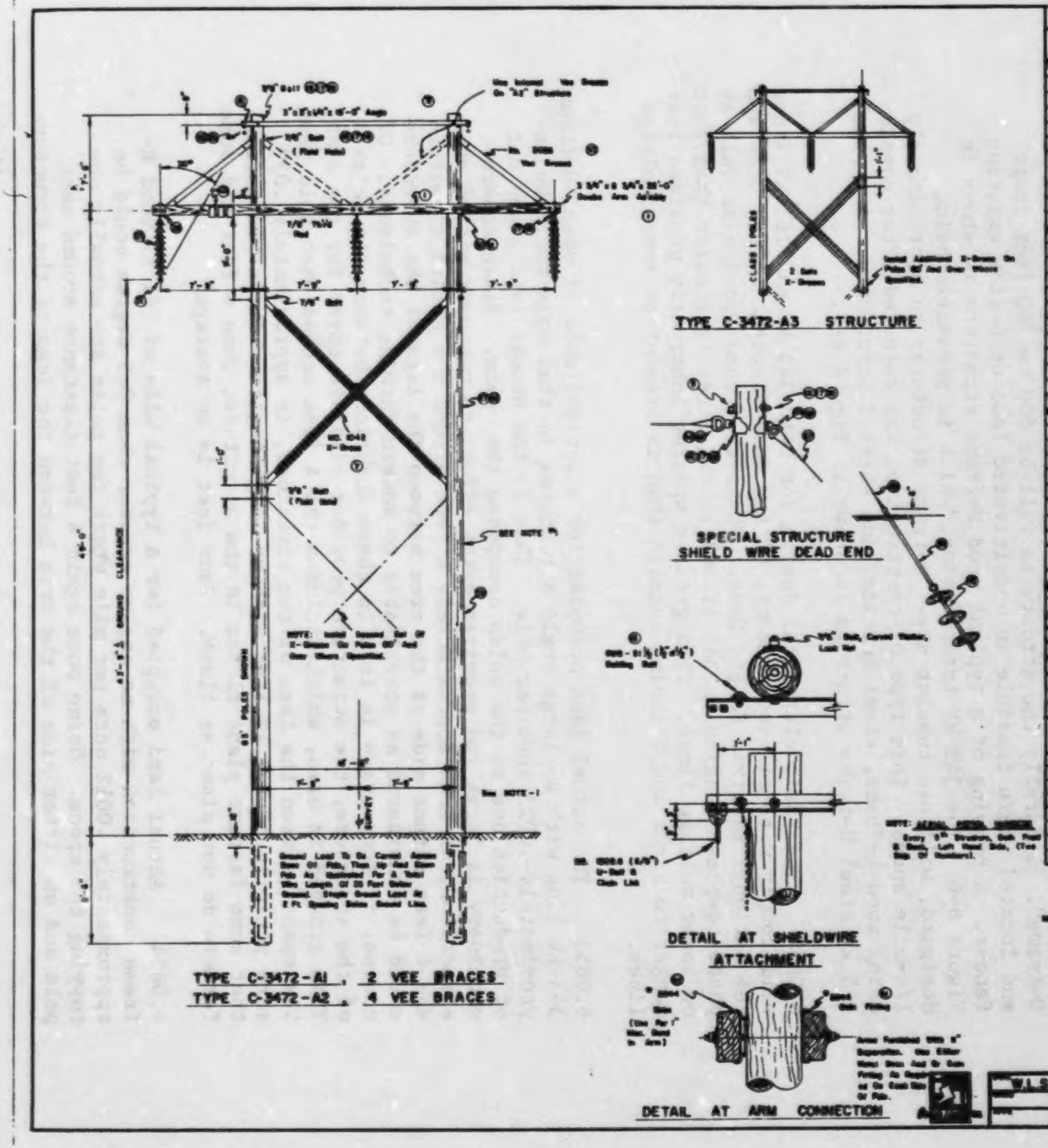
6.085 Details of Construction. Construction methods will be employed that minimize disturbances to roads, land, and improvements. During construction, rights-of-way will be maintained to avoid litter problems. Where temporary roads are required, the area will be graded to minimize soil erosion. Creek and small stream crossings will be constructed to avoid restricting the flow of water. Construction of rights-of-way will not affect ponds and shoreline wildlife habitat. Wherever possible, existing roads will be used and maintained during construction.

6.0851 The type of construction which is proposed for 161 kV lines in the Ottumwa Generating Station area is a design called "wood H-frame". Generally the structures will be 600 to 700 feet apart and located where feasible in uncultivated land or beside existing fences. A drawing of a typical wood H-frame structure is shown in Figure 6-6. The 345 kV transmission, which is presently being designed, will use tubular steel H-frame structures on approximately 1/4-mile spans. This type of construction was selected after considering wood H-frame, steel lattice, and steel Y structures. A typical 345 kV steel H-frame structure is shown in Figure 6-7.

6.0852 The basic electrical design for both 345 kV and 161 kV lines will comply with all requirements of the Iowa Electric Safety Code and the National Electric Safety Code. Phase-to-ground spacing as well as phase-to-phase spacing on 345 kV and 161 kV lines is greater than that on lower voltage lines. This greater spacing inherently provides less danger to birds and climbing animals than is present on lower voltage lines.

6.0853 The actual land occupied for a typical mile of steel H-frame 345 kV line with no large angle structures in that mile would be approximately .0023 acre per mile. This is the actual land taken out of production due to the poles occupying the space. Since modern machinery is large and requires extra effort to maneuver around obstructions, an area approximately 4 feet around the entire structure and 4 feet either side of the area between the legs of the structure could be considered as unavailable to modern farming techniques. Of course, if long grass is left in these locations between the poles of the structure, the structure provides wildlife cover for the area. This grassed in area, which includes the 4 feet around each pole plus the space between the legs of the structure, is approximately .039 acre per mile of 345 kV line with no large angles. It is recognized that some farmers plant closer to the structures than 4 feet and some farmers do not plant as close. Four feet is an average.

6.0854 Actual land occupied for a typical mile of 161 kV wood H-frame construction with no angles greater than 0.5 degree would be approximately .0012 acre per mile where the poles are actually occupying the space. Using once again 4 feet clearance around each pole and on either side of the area between the legs of the structure


5/8" Bolt
3"x3"x1/4"x15'-0" Angle
Use Internal Vee Braces On "A2" Structure
No. 5636 Vee Braces
3 3/4"x8 3/4"x32'-0" Double Arm Assembly
7/8" Volts Rod
7/8" Bolt
7/8" Bolt (Field Hole)
No. 6042 X-Brace
See Note 1
NOTE: Install Second Set Of X-Braces On Poles 80' And Over Where Specified.
80' Poles Shown
43'-9" Ground Clearance
Ground Lead To Be Carried Across Butt Of Pole, Then Up And Over Pole As Specified For A Total Wire Length Of 25 Foot Below Ground. Staple Ground Lead At 2 Ft. Spacing Below Ground Line.
Install Additional X-Brace On Poles 80' And Over Where Specified.
2 Sets X-Braces
CLASS 1 POLES
SPECIAL STRUCTURE SHIELD WIRE DEAD END
5/8" Bolt, Curved Washer, Lock Nut
DETAIL AT SHIELDWIRE ATTACHMENT
NOTE: AERIAL POLE NUMBER Every 5th Structure, Both Feet & Back, Left Hand Side, (Top Of Numbers).
Arms Furnished With 8" Separation. Use Either Metal Gains And Or Gain Fitting As Required.
DETAIL AT ARM CONNECTION

TYPE C-3472-A1, 2 VEE BRACES
TYPE C-3472-A2, 4 VEE BRACES

TYPE C-3472-A3 STRUCTURE

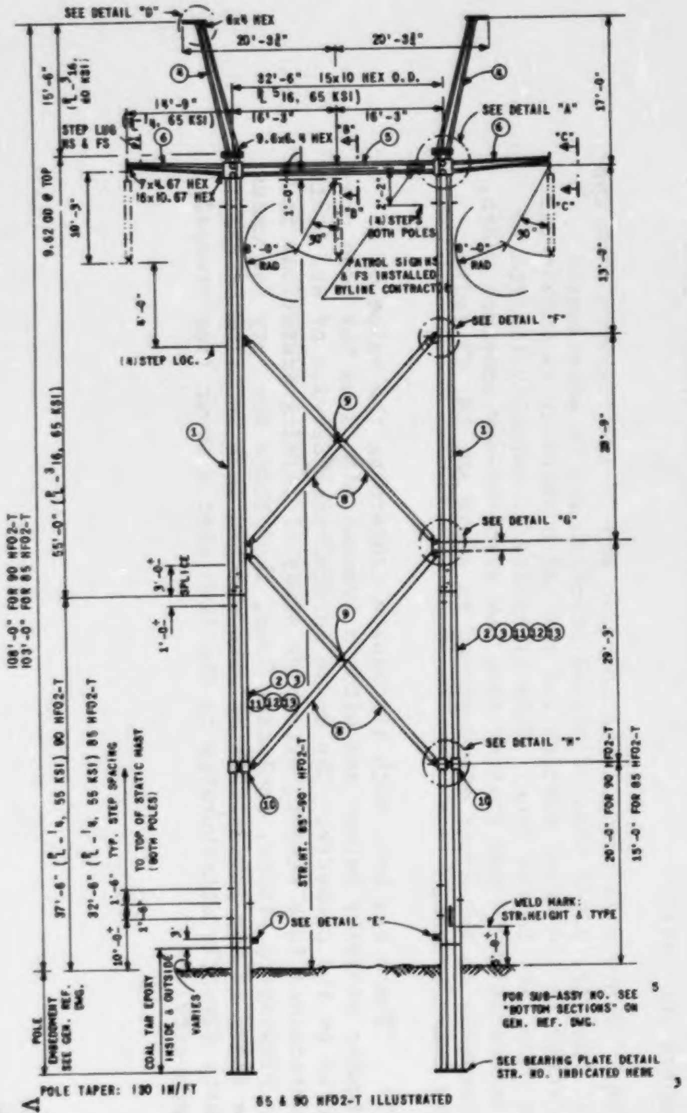
BILL OF MATERIAL			
ITEM NO.	DESCRIPTION	QUAN. REQ.	STORES ITEM NO.
#1	3 3/4"x8 3/4"x32' DOUBLE ARM ASSEMBLY	1	
	2-7/8" D.A. BOLTS W/ 2 WS & 2 STD NUTS		
	2-1" METAL SPACER FITTING		
	2-3 3/4"x8 3/4"x32' PLANK ARM		
#7	X-BRACE ASSEMBLY 15'-0" C-C SPACING	1	
	4-7/8" BOLT W/ STD NUT		
	4-3/8" CURVED WASHER		
	1- CENTER CLAMP		
#9	3"x3"x16' ANGLE IRON ASSEMBLY	1	
	1-3"x3"x16' ANGLE		
	2-5/8" U BOLT W/ CHAIN LINK		
#10	VEE BRACES	2	
15	BONDING BOLT	2	[illegible]
16	7/8" BOLT W/ STD NUT (8" LONG)	4	[illegible]
17	7/8" M.F. LOCK NUT	16	[illegible]
18	7/8" CURVED WASHER	4	[illegible]
20	CLAMP, SHIELD WIRE SUSPENSION	2	[illegible]
21	SUSPENSION CLAMPS W/SOCKET	3	[illegible]
22	BALL HOOK	3	[illegible]
26	5 3/4"x10" INSULATORS, [illegible]	27	[illegible]
27	GROUNDWIRE, #6 CU.	210	23-1300
28	STAPLES, GROUNDWIRE, CW	142	[illegible]
#29	*MOLDING, GROUNDWIRE, 8'	2	[illegible]
#30	*STAPLES, GROUNDWIRE MOLDING	8	[illegible]
33	POLE	2	[illegible]
34	PREFORMED ARMOR RODS FOR SHIELD	2	[illegible]
50	[illegible] FITTING	1	
51	[illegible] FITTING	3	
#55	BENT BOLT, 5/8"x8" (INCL. W/ITEM 1)	2	[illegible]
122	AERIAL POLE NUMBER (EVERY 5th STRUCTURE)	30 NOS.	[illegible]
	*USED ONLY AT ROADS OR STREETS.		
	FOR A2 STRUCTURE ADD:		
#10	VEE BRACE	2	
17	7/8" M.F. LOCK NUT	2	[illegible]
#55	BENT STUD. 5/8"x8" W/2 WASHERS & 2 STD NUTS	1	[illegible]
	FOR A3 STRUCTURE ADD:		
17	7/8" M.F. LOCK NUT	4	[illegible]
#7	X-BRACE ASSEMBLY 8'-6" C-C SPACING	1	
	4-7/8" BOLT W/STD NUT		
	4-3/8" CURVED WASHER		
	1-CENTER CLAMP		
	SPECIAL MATERIAL FOR SHIELD WIRE DEAD END		
37	1/2" EHS STEEL GUY STRAND	100'	[illegible]
39	7' EXTENSION	2	[illegible]
40	TRIPLE HELIX	2	[illegible]
50	POLE EYE PLATE PA [illegible]	4	[illegible]
60	THIMBLE CLEVIS PA 2720 (30,000#)	2	[illegible]
65	PREFORMED GRIP FOR 1/2" EHS STEEL	2	[illegible]
66	THIMBLE CLEVIS PA 2714 (50,000#)	2	[illegible]
86	PREFORMED GRIP FOR 3/8" EHS STEEL	2	[illegible]

ITEMS INCLUDED IN STRUCTURE

NOTE 1: STAPLE GROUND WIRE MOLDING AT 36" SPACING EXCEPT FOR DISTANCE OF 8' ABOVE GROUND WHICH REQUIRES 6" SPACING. GROUND WIRE MUST CLEAR ALL HARDWARE 4" EXCEPT WHERE BONDED.

FIGURE 6-6

W.L.S.	161 Kv CONSTRUCTION STANDARD TYPE A1, A2, A3 STRUCTURES	
	9/17/73	C-470-2	3/8"=1'-0"



85 & 90 HFO2-T ILLUSTRATED

ERECTION BILL OF MATERIAL

QTY	QTY	QTY 801687	QTY 801686	QTY 801685	QTY 801555	QTY 801554	ITEM	MARK NO.	PART NO.	DESCRIPTION
		2	2	2	2	2	1		702193	TOP SECT.(9-5/8 OD x 16-3/8 OD x 3/16 x 50'-0)
						2	2		702424	85' BOT.(15-13/16 OD x 21-7/8 OD x 1/4 x 46'-6)
					2		3		702425	85' BOT.(15-13/16 OD x 22-1/8 OD x 48'-6)
				2			11		702426	85' & 90 BOT.(15-13/16 OD x 22-3/8 OD x 1/4 x 50'-6)
			2				12		702427	85' & 90 BOT.(15-13/16 OD x 22-11/16 OD x 1/4 x 52'-6)
		2					13		702428	90' BOT.(15-13/16 OD x 22-15/16 OD x 1/4 x 54'-6)
		←				2		**	600473	STATIC MAST
		←				8				3/4 Ø x 3 HEX HEAD BOLT (A-325)
		←				8	4			3/4" HEX NUT (A-325)
		←				8				3/4" LOCKWASHER
		←				1	5	3 **	600474	INB. ARM (15 x 10 HEX x 5/16 x 32'-6)
		←				2		**	600475	OUT. ARM (16 x 10.67 HEX x 7 x 4.67 HEX 1/4 x 14-9)
		←				4	6			1-3/8 Ø x 19" THRU BOLT (A-193 B-7)
		←				8				1-3/8" HEX NUT (A194-2H)
		←				8				1-3/8" LOCKWASHER
		←				2	7			1/2 Ø x 1-3/4" S.S. HEX HD. BOLT
		←				4				1/2" S.S. LOCKWASHER
		←				4			600477	X-BRACE TUBE (6-5/8" OD x 41'-6-3/4) 35 KSI
		←				8	8			1 Ø x 3 HEX HEAD BOLT (A-325)
		←				8				1" HEX NUT (A-325)
		←				8				1" LOCKWASHER
		←				2			507780	3/4 Ø U-BOLT A-36
		←				2			507784	BACK-UP PLATE 33 KSI
		←				4	9			3/4" REG. HEX NUT A-307
		←				4				3/4" LOCKWASHER A-307
		←				2			507911	X-BRACE BAND 12 x 1/2 x 2'-4-9/16 (65 KSI)
		←				2			507912	X-BRACE BACK BAND (SAME)
		←				8	10			1 Ø x 13" THRU BOLT (A-193 B-7)
		←				16				1" HEX NUT (A194-2H)
		←				16				1" FLAT WASHER
		←				16				1" LOCKWASHER

QTY	ASSEMBLY NUMBER	HEIGHT	EMBEDDMENT	GROUND LINE O.D.	APPROX. STRU. WT.
*	801554	85'-0	SEE CHART	SEE CHART	14,745 #
*	801555	85'-0	SEE CHART	SEE CHART	14,980 #
*	801685	85'&90'	SEE CHART	SEE CHART	15,230 #
*	801686	85'&90'	SEE CHART	SEE CHART	15,475 #
*	801687	90'-0	SEE CHART	SEE CHART	15,730 #

* QTY. INCOMPLETE AT PRESENT

NOTE:

FOR DETAILS & SECTIONS, SEE DRAWING 801556 SHEET 2 OF 2

** FOR THE STR. #65 ⚠5 USE THE SPECIAL CROSSARMS PART NO. 600703 AND THE SPECIAL STATIC MAST PART NO. 600705 AND THE SPECIAL INBOARD CROSSARM PART NO. 600716 ⚠3

345 KV SHORT SPAN TANGENT STR.
90' & 85' HFO2-T ERECTION DETAILS

IOWA SOUTHERN UTILITIES COMPANY

FIGURE 6-7

as land which is unavailable to modern farming techniques, approximately 0.035 acre per mile of 161 kV wood H-frame would be unavailable for farming.

6.0855 As larger angles are required to be added to the lines to follow routes which are not straight or to deviate around buildings or other obstructions, the land usage increases significantly above the previously listed values due to larger footings, wider structures, more structure legs, or anchors which are required for the angles. The total land usage as calculated for any specific route is peculiar to that route and the structures required for that route.

6.0856 Since normal crop production and normal land usage can be continued underneath the line at all points with the exception of those described, very little land is actually removed from production. Experience has shown that crop production does continue on the easement strip underneath the transmission line. If this area were an initially wooded area, trees or shrubs can be replanted in the right-of-way but these trees should be trees which will not grow to great height and which will not become a hazard to the operation of the line. Low trees or shrubs which are for purposes of controlling soil erosion or providing game cover and beautification are permitted, but when such plantings are made, it is essential that the Company be informed of such replanting so that these plantings will not be damaged or cut by right-of-way maintenance crews.

6.0857 The existence of transmission lines through a cultivated area does not prohibit aerial spraying in the area. The line does, of course, present another obstacle which the aerial sprayer must recognize and avoid.

6.0858 There will normally be no radio and TV interference from the line. However, minor loss of signal strength may be experienced when tuned to a distant station and the radio receiver is within very close proximity to the line. This proximity is normally limited to a distance which is not greater than the right-of-way easement width. All hardware on the lines are designed to avoid AM, FM, CB radio, and TV interference.

6.0859 There has been much discussion concerning the value of a particular property before and after a transmission line has been constructed on the property. The Doane Agricultural Service of St. Louis has determined in a recent, extensive study of farming operations in seven Midwestern states, including Iowa, that there are very few cases where there is any perceptible or acknowledged loss in value of the property directly attributable to the fact that a power line crossed the property.

6.08510 When poles are located along a highway or on highway property, all Department of Transportation regulations are observed which includes locating the poles at least 30 feet from the edge of the roadway.

6.08511 The time required between the initial recognition of the need for a line and the planning, the engineering, the route selection and franchise approval for the line may require from 2 to 4 years or longer. The actual construction time required for a transmission line approximately 20 to 30 miles long is approximately 6 to 7 months. All of the OGS area transmission system described above is required to be in service by late 1980 when OGS starts operating to assure reliable and adequate service to customers as required by Code.

6.086 General Route Evaluation of the Alternative Routes for the OGS-Montezuma 345 kV Line and for the OGS-Wapello County 161 kV Line No. 2. The alternative routes for the OGS-Montezuma 345 kV line and the OGS-Wapello 161 kV line lie in one or more of the following counties: Poweshiek, Mahaska, and Wapello. Study was made to characterize typical soil types and the significance of historical sites in these areas.

6.0861 All routes are characterized by the combination of cultivated land and timberland in the flood plain of the Des Moines River near the OGS plant. The transition land between the flood plain and the upland is rolling land used for timber, pasture, and cultivation. Several strip mines have operated in this area during prior years of high coal productivity.

6.0862 The upland soils along the routes are silty clay loam and clays and dark loam soil. This land is used for pastures, hay, and cultivated crops (e.g., corn, beans, small grains).

6.0863 The 1976 issue of "National Register of Historic Places" lists the following items of historical significance in these counties:

a. Mahaska County, Oskaloosa. Daniel Nelson house and barn. Sec. Rt. 1, 19th century. This house and farm is now a museum located on approximately one acre of land which remains from the original farm complex of approximately 100 acres.

b. Wapello County, Eldon. American Gothic House, Dibble House, Burton and Gothic Streets, 1881. This is the old house in the famous painting "American Gothic," 1931, by Grant Woods.

c. Wapello County, Ottumwa Vicinity, SE of Ottumwa. Mars Hill--the Mars Hill Church and Cemetery, 1850's. The small log church at Mars Hill was thought to be a stop on the underground route during the Civil War.

d. Poweshiek County. No listings.

6.0864 None of the alternative routes will impinge upon any of these historic sites.

6.087 Routing Alternatives for OGS-Montezuma 345 kV Line. Several alternative routes have been considered in a corridor approximately 9 miles wide and extending north and slightly west of Chillicothe, Iowa (OGS plant site) to the existing 345 kV line between Des Moines and Iowa City. The lengths of the various alternatives vary from approximately 36 miles to approximately 43 miles. All alternative routes cross the Des Moines River and small streams and tributaries. These routes are shown on Figure 6-8 labeled with Roman numerals and outlined by the legend. Other possible alternatives exist by the combination of the basic labeled routes.

6.0871 These several alternatives may be divided into two categories. One category contains routes which are essentially straight north from the OGS plant through timber, pasture, and farmland and represent the least mileage alternatives and the least adverse land use. Each of these routes transverses essentially the same type and quantity of land.

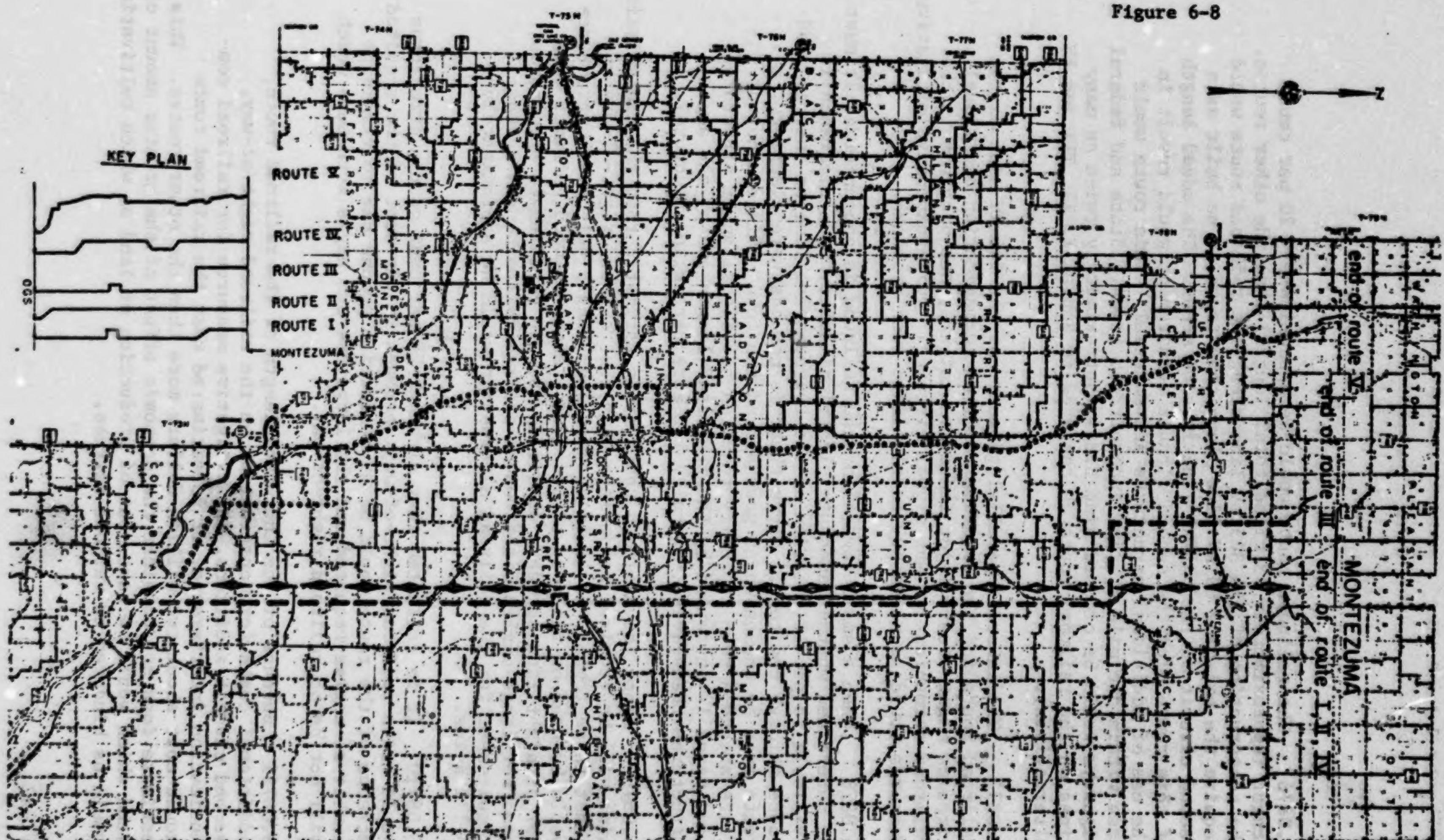
6.0872 Another alternative route, labeled as Route V, is the path following the existing railroad right-of-way from OGS to just north of Searsboro. This route meanders north and northwesterly on a route which terminates on the existing Des Moines-Iowa City 345 kV line about 7 miles west of Montezuma and just north of Searsboro.

6.0873 Analysis of land use on the alternative routes which are essentially straight north of the OGS plant (Routes I through IV) gives approximately the same number of structures in cropland, pastureland, timberland, and wasteland for each route in the corridor.

6.0874 Approximately 19 per cent of the structures lie in timber or waste area and about 16 per cent are in pasture and hay land. Although approximately 65 per cent of the structures are adjacent to or lie in tillable farmland, only about 21 per cent of these farmland structures are in open farmland. The other 79 per cent of the farmland structures lie in fence lines, wasteland, and along roads adjacent to the farmland with a consequent minimal adverse land use.

6.0875 Assuming 4 feet around poles plus the area between poles to be unavailable for production in cropland, pastureland, and timberland results in about 3-1/2 to 4 acres of total land would be unavailable for production on any of the routes lying straight north of the plant. Routes I, II and IV pass within one mile of only one incorporated town. Routes II and IV contain four state and federal highway crossings and Routes I and III contain five state and federal highway crossings.

Figure 6-8


N
end of route V
end of route III
MONTEZUMA
end of route I, II, IV
WASHINGTON
PLEASANT
SCOTT
SUGAR CREEK
UNION
JACKSON
PRAIRIE
PLEASANT GROVE
UNION
BLACK OAK
MADISON
WHITE OAK
CEDAR
GARFIELD
SCOTT
CREEK
WEST DES MOINES
EAST DES MOINES
JEFFERSON
COLUMBIA
KEY PLAN
ROUTE V
ROUTE IV
ROUTE III
ROUTE II
ROUTE I
MONTEZUMA
OGS
T-73N
T-74N
T-75N
T-76N
T-77N
T-78N
T-79N

6.0876 The railroad route would be approximately 20 per cent longer (approximately 43 miles total length) than the other routes. The construction of the 345 kV line along the railroad route would require the existing 69 kV line along that route to be built as a second circuit on the 345 kV line in some areas. The added length of this route plus the second circuit requirement would result in the use of additional structures and material. This route would pass within one mile of five incorporated towns. State and federal highways would be crossed nine times (approximately twice as many times on the railroad route as compared to Routes I, II, III and IV alternatives).

6.0877 The inherent parallel geometry of the 345 kV line on the railroad route and the existing railroad communication and signal circuits might create major inductive interference problems in the railroad communication and signal circuits. Quite expensive mitigative measures would be necessary to eliminate such problems.

6.0878 When a small town along the railroad is encountered, it must be determined whether adequate electrical safety code clearance is available to permit location of the transmission line on the railroad route through the town. Where there is not adequate clearance, a route must be chosen which goes around the town. Since a detour route around a town typically requires additional angle structures, land usage is increased by the increased length and by the angle structures themselves (typically 1/2 acre per angle structure).

6.0879 Along the railroad route it is estimated that the transmission line will be required to deviate from the railroad right-of-way at least three towns. If it is assumed that single pole steel structures would be used on railroad right-of-way, steel or wood H-frames used for straight line segments around towns, and guyed angle structures used for large angles either on or off the railroad, the acreage requirement for the railroad alternative would be approximately 6-1/2 acres.

6.08710 It is estimated that although 78 per cent of the structures would be on railroad right-of-way, perhaps 95 per cent of the required acreage of the route would be on productive ground due to the large number of angles required and the large use per angle structure which will not be on railroad right-of-way.

6.08711 Because of the increased length of the railroad route, additional costs for construction on the railroad right-of-way, second circuit additions, and mitigative measures for railroad communication interference, it is estimated that the railroad route could cost about two million dollars more than the other routes. This estimate does not consider the economic effect of the greater amount of land which would be taken out of production or land on which cultivation would be hindered to various degrees.

6.088 Route Alternatives for the OGS-Wapello No. 2 161 kV Line. The alternatives available for connecting a 161 kV line between the OGS station and the Wapello County Substation may be categorized into two groups: the routing of lines via existing railroad lines running adjacent to the Des Moines River, or the more southerly route which passes over timberland, pastureland, and cropland.

6.0881 Several alternative routes are shown in Figure 6-9 and outlined by the legend.

6.0882 Problems which are encountered on the railroad routes are similar to those of the 345 kV line from OGS to Montezuma. Again, the parallel geometry of the 161 kV line and the railroad communication circuits could create inductive interference problems in the railroad communication circuits. Mitigative measures would have to be provided to eliminate these problems. The railroad routes would cut directly through the City of Ottumwa.

6.0883 The construction of a 161 kV circuit along the CRI&P Railroad would require the existing 69 kV line to be rebuilt as a second circuit on Routes II, III, and IV (railway routes) within Ottumwa.

6.0884 These problems would be more costly economically than the added cost of a longer, southerly route through timberland, pastureland, and cropland.

6.0885 The total land use via a typical southern route has been approximated to be about 1-1/2 acres which includes woodland and wasteland. Total land usage along the railroad routes would be approximately 1/2 to one acre.

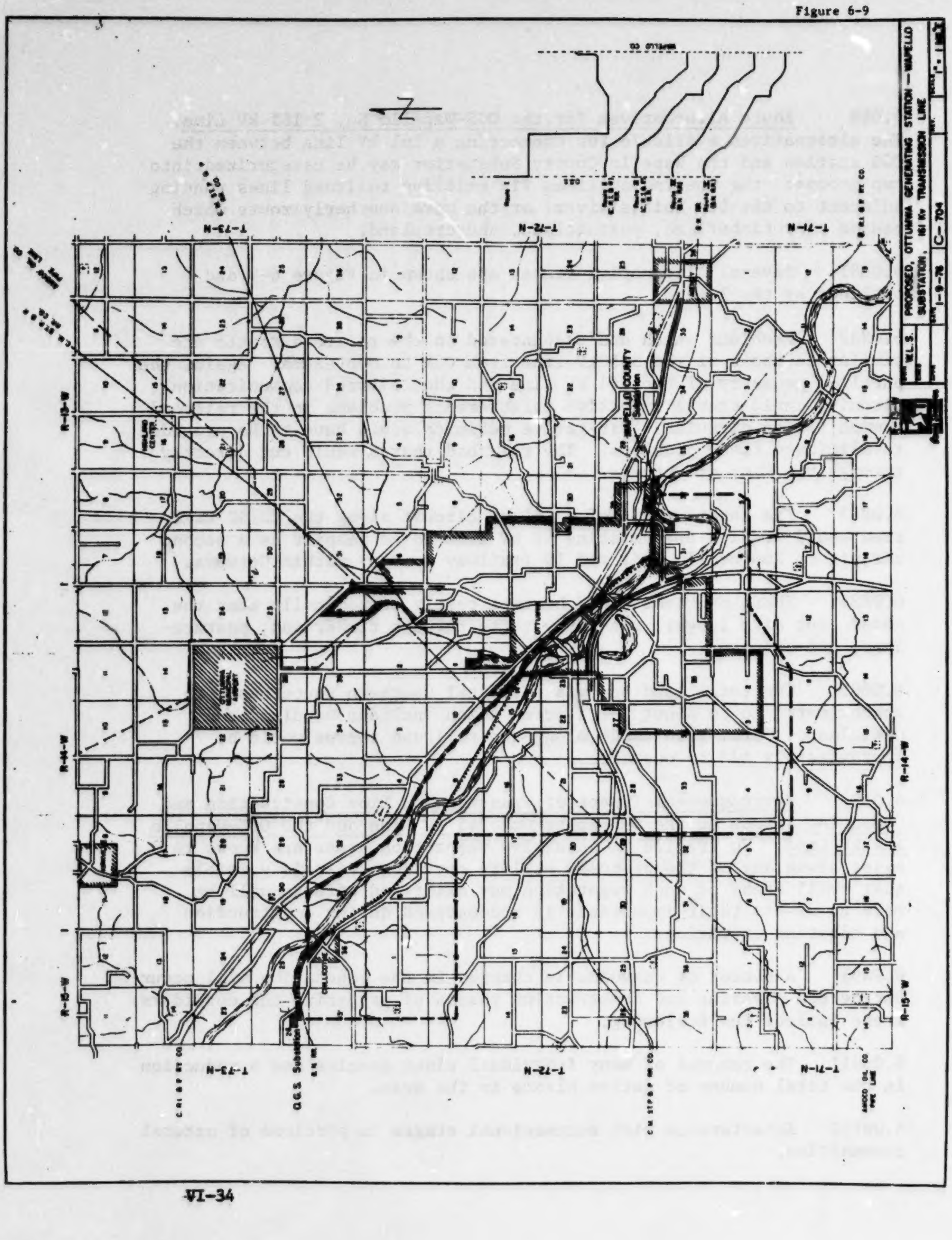
6.089 Environmental Impact of Transmission Line Construction and Operation Common to the OGS-Montezuma 345 kV Line and the OGS-Wapello 161 kV Line. No fragile or sensitive vegetation areas are known to exist along any of the proposed utility corridors. It is possible that small areas of such vegetation may exist and efforts will be made to assess their importance if encountered during construction and clearing operations.

6.0891 A number of unavoidable changes in the vegetation will occur during the clearing and construction phases of preparing the corridors. These include the following.

6.08911 The removal of many individual plant species and a reduction in the total number of native plants in the area.

6.08912 Interference with successional stages in portions of natural communities.

Figure 6-9


PROPOSED, OTTUMWA GENERATING STATION — WAPELLO SUBSTATION, 161 Kv TRANSMISSION LINE
W.L.S.
1-9-78
C- 704
1" = 1 MILE
WAPELLO COUNTY Substation
O.G.S. Substation
T-73-N
T-72-N
T-71-N
R-15-W
R-14-W
R-13-W
HIGHLAND CENTER
CHILLICOTHE
WAPELLO CO

6.08913 Creation of erosion potential by the removal of ground cover species and superficial soil.

6.08914 Promotion of increased numbers of weedy species in agriculture use areas and in the middle of natural vegetation areas.

6.08915 Some disruption of agricultural operations and loss of food production.

6.08916 A change in the appearance of the vegetation from its pleasing state to a less attractive state.

6.08917 Adverse effects on recreational use of the area.

6.08918 Damage to standing timber during construction of the lines.

6.0892 The proposed lines will traverse either timberland, cropland, or pastureland, but will not have a dramatic effect on resident or migratory birds, mammals, or reptiles in the area. The major impact on wildlife can be expected when the line dissects wooded tracts in the area. Even here the direct impact on most highly mobile wildlife will be simply one of causing them to move to adjacent wooded areas.

6.0893 Resident birds and game mammals could be adversely affected by the removal of den and nesting trees, although judicious location of the line would avoid much of this impact.

6.0894 Soils along the proposed route are not subject to excessive erosion. However, soil erosion can be expected to some degree throughout the corridor during construction and will be confined to the following areas: tower foundation excavations, material storage yards, croplands, and other sites subjected to unusual compaction or rutting of soil from vehicles.

6.0895 Construction of the proposed transmission line will result in a small increase in sediment loading for the various streams crossed by these lines. Since most of these streams along the route pass through cropland or pasture areas, the impact will be minimal because these drainage areas are already exposed to some amount of agricultural silt.

6.09 Alternate Particulate Removal Methods.

6.091 Introduction. Particulate emissions will be controlled at the Ottumwa Generating Station by the use of an electrostatic precipitator. The following alternative systems for particulate removal were considered: flue gas wet scrubber, wet scrubber and precipitator combination, and baghouse fabric filter.

6.0911 Any system that would be selected would be specified to treat a given amount of flue gas and to have a given dust removal efficiency. Therefore, the environmental effects; i.e., how much particulate would be emitted from the stack, would be equal with all the systems.

6.0912 If the specifications were the same for each of the alternatives, then the criteria for selection must consider whether the system would perform as specified (initial and long-term performance); environmental effects; and cost. Alternative systems are discussed in the following section.

6.092 Methods Evaluated.

6.0921 Flue gas wet scrubber. It is unlikely that a flue gas wet scrubber can be purchased with a guaranteed particulate removal efficiency equal to that of an electrostatic precipitator; i.e., greater than 99 per cent. Provided the performance specifications could be met, it is doubtful that a flue gas wet scrubber could demonstrate the long-term performance and reliability of a precipitator.

6.09211 A flue gas scrubber would remove some sulfur dioxide from the flue gas; however, with the low-sulfur coal to be used for fuel, the possible benefits from sulfur removal would be minimal. A number of negative effects would result including the use of natural resources (limestone, water, and additional fuel) and the production of large quantities of solid and liquid reaction by-products which would present a potential for land and water pollution.

6.09212 Finally, the cost of a flue gas wet scrubber would be higher than the cost of a precipitator.

6.0922 Wet scrubber and precipitator combination. With a combination system the probability of meeting the performance requirements would be about the same, or perhaps slightly lower, than with the precipitator alone.

6.09221 The long-term efficiency and reliability of a combination system would be no greater, and probably considerably less, than that of the precipitator alone.

6.09222 Secondary environmental effects for the combination system would be the same as for the scrubber alone, except for still higher fuel usage (to generate the power required to operate both systems).

6.09223 The cost of a combination system would be about 10 to 20 million dollars more than the cost of a precipitator.

6.0923 Baghouse fabric filter. A well-designed fabric filter would have the greatest probability of meeting the performance requirements than the other systems considered.

6.09231 The use of fabric filters in central station coal-fired utilities is a relatively recent application. Operating experience, reliability, and maintenance cost have not been established.

6.09232 Environmental effects would be about the same for either a fabric filter or precipitator.

6.09233 The initial costs would be approximately the same for either system.

6.10 Alternate Sulfur Dioxide (SO_2) Removal Methods.

6.101 The western coal to be used for fuel at Ottumwa Generating Station has a sulfur content of about 0.5 per cent. Because of the low sulfur content, sulfur dioxide emission will comply with regulatory requirements and no removal treatment is contemplated. The generating station has been designed to accommodate sulfur dioxide removal equipment should a coal with higher sulfur content be used for fuel in the future or if regulatory requirements should change.

6.11 Alternative Ash Disposal Methods.

6.111 The following methods of ash disposal were considered for the Ottumwa Generating Station.

6.1111 Local Off-Site Disposal. The development of an off-site disposal area for bottom ash and dry ash would result in higher operating costs. In addition to on-site disposal being less expensive, handling and disposal methods can be better controlled, and any environmental effects can be efficiently monitored.

6.1112 Shipment of Ash Back to the Mine. It would be possible that the ash could be shipped back to the western coal mine in coal railcars. The costs of preparing the ash for shipment and for transportation are considered prohibitive. There also would be a sizable expenditure of energy in returning the ash to the mine site.

6.1113 Marketing of Fly Ash. There is a limited market potential for fly ash. Fly ash has been used in the manufacture of cement and as an additive for concrete. If a suitable commercial outlet could be developed, the fly ash from the Ottumwa Plant could be sold. Facilities would have to be provided for storage and loading of fly ash into trucks or train cars for shipment to market. Based on present demand, considerably more fly ash would be produced than could be sold.

6.12 Alternate Cooling Methods

6.121 Introduction. There are several alternative cooling systems available for power plants. Basically, each alternate process represents a different method for the disposal of the unrecoverable energy in the exhaust steam discharged from the steam turbine.

6.1211 Fossil fuel (or nuclear fuel) is used to provide energy to generate steam which then is expanded through steam turbines where a portion of the heat energy of the steam is converted to mechanical energy to drive an electrical generator. Much of the heat energy in the steam is thermodynamically unavailable to produce mechanical-electrical energy, and it must be discharged.

6.1212 The transfer of unavailable heat (i.e. waste heat) in the exhaust steam is carried out in a sequence of three general steps. The heat is first transferred to an intermediate heat-transport fluid (circulating water); secondly, the heat is transferred by the cooling system to the atmosphere; and, finally, the heat is passed to the ultimate heat sink which is outer space.

6.1213 A condenser is commonly used to transfer unavailable heat energy discharged from the steam turbine. There is a shell housing tubes through which circulating water flows. Steam condenses on the outside of the tube surfaces as the heat transfers to the circulating water. The circulating water transports the heat to some type of cooling facility where it is dissipated ultimately to space.

6.1214 Cooling systems differ in the manner in which the final transfer of waste heat from the circulating water to the environment is accomplished. There may be a direct transfer of heat from the water to the atmosphere, or the circulating water may be discharged into and mixed with a large body of water where the waste heat transfers to the atmosphere.

6.1215 With all the processes, heat is transferred from the circulating water to the atmosphere by the following mechanisms.

6.12151 Conduction and convection of heat directly to the air.

6.12152 Radiation of heat from the higher temperature water surfaces to the lower temperature of the atmosphere.

6.12153 The evaporation of a portion of the circulating water (or receiving water) with the transfer of heat from water to water vapor which is diffused into the atmosphere.

6.1216 Whether waste heat is transferred directly to the atmosphere or it is eventually transferred from large bodies of water, the same fundamental mechanisms of heat transfer apply. The amount of waste heat transferred by the mechanisms listed varies with the different cooling systems. The total heat transferred, however, is equal to the waste heat discharged to the circulating water through the steam condenser. (It should be noted that although it is possible to directly transfer from exhaust steam to the atmosphere through a heat exchanger, this method is applicable only on a limited basis).

6.122 Types of Cooling Systems. Alternate cooling systems that are considered feasible for large electric-generating units include the following.

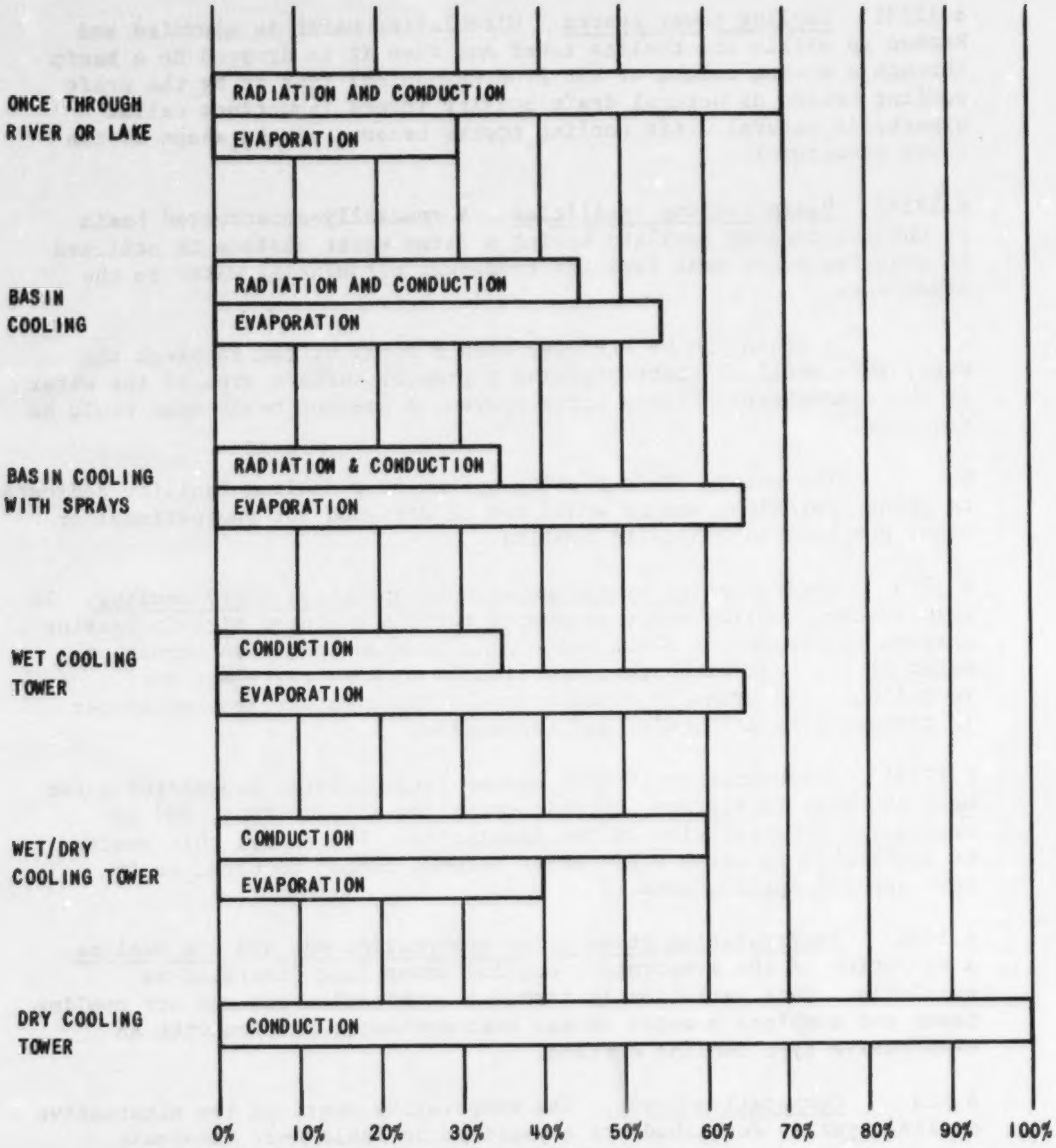
- Once-through cooling system
- Recirculating system using evaporative (wet) cooling
- Recirculating system using nonevaporative (dry) cooling
- Recirculating system using combination wet and dry cooling

6.1221 Once-through cooling system. This process uses river or lake water circulating in a continuous circuit through the tubes of a condenser, absorbing the waste heat, and then returning to the water body. The transfer of heat to the atmosphere then occurs because of the temperature difference between the water and the atmosphere.

6.12211 Features of once-through systems include an intake structure, circulating water pumps to provide static and dynamic head losses, the condenser, conduits to carry water, and a discharge structure located so that significant recirculation of warm water will not occur. This type of cooling system has been utilized where natural bodies of water of adequate quantity are available. Once-through cooling is not practical for Ottumwa Station because there is not an adequate supply of water available from the Des Moines River during periods of low flow.

6.1222 Recirculating system using evaporative (wet) cooling. In this system, heat is transferred directly from the circulating water surfaces to the atmosphere employing equipment and structures specifically designed and constructed as a part of the plant. Heat transfer is a result of a combination of evaporation and conduction with some radiation. There are several forms of this system that differ in technical details, costs, and operating problems. The following types of such cooling systems are available.

FIGURE 6-10



HEAT TRANSFER MECHANISMS
WITH ALTERNATIVE COOLING SYSTEMS

SOURCE: WOODSON, R.D., NOVEMBER 30, 1972.

6.12221 Cooling tower system. Circulating water is elevated and broken up within the cooling tower and then it is dropped to a basin through a moving column of air from mechanical fans or by the draft cooling towers or natural draft cooling towers (sometimes called hyperbolic natural draft cooling towers because of the shape of the tower structure).

6.12222 Basin cooling facilities. A specially-constructed basin or channel-cooling facility having a large water surface is utilized to transfer waste heat from the condenser circulating water to the atmosphere.

a. A basin can be equipped with a spray system to break the water into small droplets exposing a greater surface area of the water to the atmosphere. With a spray system, a smaller basin area would be required.

b. The entire basin cooling system is a cooling facility dedicated to plant operation, and it would not be designed for recreational or other purposes unrelated to cooling.

6.1223 Recirculating system using nonevaporative (dry) cooling. In this system, cooling water is pumped through a closed circuit passing through the condenser where waste heat is absorbed, then through a water to air heat exchanger, and finally back to the pumps for recycling. The transfer of heat in the water to air heat exchanger is primarily by conduction and convection.

6.12231 Disadvantages of this system include large expenditures for heat exchange facilities, certain operating difficulties, and the very large physical size of the facilities. Presently, this system is applicable in areas where other methods cannot be used, or in very special applications.

6.1224 Recirculating steam using combination wet and dry cooling. A variation of the evaporative cooling tower just described is available. This variation is termed a combination wet and dry cooling tower and combines a water to air heat exchanger section with an evaporative type cooling section.

6.123 Comparative Costs. The comparative costs of the alternative cooling systems described are summarized in Table 6-3. Economic parameters used to develop capital investment costs and annual cost include the following.

- Annual fixed charges of 15.92 per cent

TABLE 6-3

COMPARATIVE COSTS OF ALTERNATE COOLING SYSTEMS

FOSSIL FUEL PLANT WITH
675 MW NET PLANT OUTPUT

Type of Cooling System*	Capital Investment $	Annual Fixed Charges $	Annual Operation and Maintenance $	Total Annual $	Capital Equivalent of Total Annual Costs $
Mechanical Draft Wet Tower	10,300,000	1,640,000	667,000	2,307,000	14,491,000
Natural Draft Wet Tower	14,400,000	2,292,000	566,000	2,858,000	17,952,000
Mechanical Draft Dry Tower	24,900,000	3,964,000	4,790,000	8,754,000	54,987,000
Mechanical Draft Wet/Dry Tower	12,600,000	2,006,000	712,000	2,718,000	17,073,000

*Once-through cooling is not practical for OGS because of limited water supply available from Des Moines River. Basin cooling is not feasible because of the topography of the plant site area.

- Inclusion in capital cost of 20.75 per cent as general indirect investment costs
- Plant capacity factor--55.8 per cent
- Cost in 1975 dollars
- Cost of electric power requirements at $26.59 per kW per year
- Cost of electric energy consumption at 11 mills per kWh

6.1231 Mechanical draft wet towers are the most economical cooling system of those practical for the Ottumwa Generating Station.

6.124 Comparative Utilization of Natural Resources. Table 6-4 shows the comparative utilization of important natural resources for each of the alternate cooling systems. (Water use at 100 per cent load capacity for draft cooling towers is shown in Table 1-4.)

6.125 Qualitative Ranking of Cooling System Characteristics. Table 6-5 shows the comparative qualitative ranking of each alternative for a number of individual cooling system characteristics. The sum of the qualitative rankings for each system represents an approximation of the quantitative ranking of the alternative systems.

6.1251 As shown in Table 6-5 draft cooling towers ranks as one of the more desirable systems.

6.126 Selection of Cooling System for Ottumwa Station. Draft cooling towers were selected for use at Ottumwa Station primarily on the basis of environmental considerations, economics, utilization of natural resources, and desirable characteristics. Water from the Des Moines River will be recycled for plant use as much as possible, and there will be no thermal impacts as a result of wastewater discharges. Blowdown from the cooling towers will be used for bottom ash sluicing and finally discharged to the bottom ash basin prior to discharge to the river.

TABLE 6-4

COMPARATIVE UTILIZATION OF NATURAL RESOURCES WITH ALTERNATIVE COOLING SYSTEMS FOR FOSSIL FUEL PLANT WITH 675 MW NET PLANT OUTPUT

(55.8 per cent annual load factor)

Type of Cooling System	Net Generating Capacity kilowatts	Net Plant Heat Rate Btu/kWh	Fuel Input Billions of Btu/yr	Coal Consumption 8020 Btu/lb tons/yr	Water Consumption (Evaporation) acre-ft/yr	Land Area acres
BASE REQUIREMENTS						
Once-through River or Lake Cooling System[a]	675,000	10,000	32,995	2,057,000	2,650	--
ADDITIONS TO BASE REQUIREMENTS						
	Aux Power kilowatts					
Alternative Cooling Systems						
Mechanical draft wet tower	4,390	77	254	15,800	6,300	15
Mechanical draft wet/dry tower	5,430	86	284	17,700	2,800	15
Mechanical draft dry tower	17,600	1,123	3,705	231,000	(2,800)[b]	6
Natural draft wet tower	3,040	59	195	12,200	6,300	15

[a] Not practical for the Ottumwa Generating Station.

[b] Denotes decreased requirements.

TABLE 6-5

QUALITATIVE RANKING OF COOLING SYSTEM CHARACTERISTICS

	Once-through Cooling	Dry Cooling Towers	Wet-Dry Cooling Towers	Mechanical Draft Cooling Towers	Natural Draft (Hyperbolic) Cooling Towers
1. Comparative Cost	1	5	3	2	3
2. Ability to Satisfy Cooling Requirements	1	2	2	1	1
3. Availability	1	4	3	1	1
4. Low Temperature Adaptability	2	5	5	3	4
5. Fire Risk	1	1	3	3	2
6. Windstorm Risk	1	2	3	2	5
7. Seismic Risk	2	2	2	1	5
8. Ability to Tolerate Airborne Debris	2	3	2	1	1
9. Corrosion Resistance	2	3	3	1	1
10. Maintenance Requirements	2	5	3	2	2
11. Land Requirements	1	3	2	2	2
12. Arrangement of Plant Facilities	2	4	1	2	1
13. Arrangement of Site	5	1	1	1	1
14. Impact on Water Resources	2	1	2	4	4
15. Atmospheric Concerns	1	1	2	3	3
16. Extent of Field Construction	3	3	2	1	4
Approximation of the Quantitative Ranking of Alternate Cooling Systems*	29	45	39	30	40

Ratings are qualitative only and are ranked from 1 to 5 in order of desirability with respect to each characteristic, with 1 being the most desirable and 5 being the least desirable.

*Sum of qualitative rankings.

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Woodson, R.D., November 1972, Cooling Alternatives for Power Plants, Presented to the Minnesota Pollution Control Agency.

6.13 Alternate Water Supply

6.131 Introduction. A permit has been issued by the Iowa Natural Resources Council which authorizes the withdrawal of water from the Des Moines River for consumptive use at the Ottumwa Generating Station (permit number 4851). A condition of the permit prohibits water withdrawals when the flow of the river is less than 300 cfs. Various alternatives were considered by Iowa Southern Utilities Company which would provide a supply of water during periods of low flow conditions of the Des Moines River and a preferred plan was recommended. The three most feasible alternatives were the following.

6.132 Water from Red Rock or Saylorville Reservoirs. The possibility of leasing storage space from the reservoirs has been explored with the U.S. Corps of Engineers. There are some reservations about the Corps lowering the level of the reservoirs during periods of drought because of possible opposition by recreational interests. To date, agreement has not been reached between ISU and the Corps.

6.133 Construction of Water Impoundment Near OGS. It would be very costly to construct an impoundment in comparison to the other two alternatives considered. Land would have to be acquired for the site, and it would be necessary to construct a pipeline to fill the impoundment from the Des Moines River. About 300 acres for land now used previously for agricultural purposes would be needed. This alternative was judged to be not as acceptable as the other plans considered.

6.134 Water from Lake Sundown. Iowa Southern Utilities Company owns an option to purchase a 450 acre impoundment located in Appanoosa County on South Soap Creek known as Lake Sundown. A plan to utilize this lake as a water supply during low flow periods of the Des Moines was submitted for approval by the Iowa National Resources Council on June 22, 1978. Upon approval of the plan, Iowa Southern Utilities Company will proceed to complete purchase of the facility.

6.1341 The following equipment will be installed and arrangements made.

6.13411 Both intake and discharge at OGS will be monitored so this net consumptive use can be determined.

6.13412 A Weir or Parshall Flume will be installed at Lake Sundown so that the discharge can be monitored.

6.13413 Arrangements will be made so that ISU operating personnel have daily access to the Des Moines River gage reading at Ottumwa.

6.1342 The following operating procedures will be followed.

6.13421 Release of water to South Soap Creek will being within 6 hours after ISU receives the second consecutive daily river level reading indicating that the flow at the Ottumwa gage is less than 300 cfs.

6.13422 The amount of water released to South Soap Creek will be 150 per cent of the deficiency of flow under 300 cfs at Ottumwa or 150 per cent of the net consumptive use at OGS, whichever is the lesser amount.

6.13423 Release of water to South Soap Creek will be discontinued no sooner than 24 hours after the Des Moines River flow at Ottumwa returns to 300 cfs.

6.1343 This plan will cease to operate in the event that Red Rock Lake is emptied by an extreme drought and the U.S. Army Corps of Engineers is unable to maintain a flow of at least 100 cfs at the Ottumwa gage.

6.1344 During the recent drought in 1976-1977, this plan would have operated approximately 45 days. Historically, drought periods such as this occur about every 20 years; on that basis this plan would operate approximately 45 days in the 33 year life of the plant beginning in 1981.

6.1345 This plan apparently would result in little impact on the water quality of the Des Moines River. As shown in Table 6-6, the water quality characteristics of Soap Creek and the Des Moines are about the same. The discharge of Soap Creek water to the Des Moines should have no significant or adverse effects on water quality.

6.1346 This plan has been discussed with Ottumwa Water Works officials, the City Engineer at Ottumwa, and appropriate state and federal agencies. Letters are on file from the General Manager of the Ottumwa Water Works and from the Ottumwa City Engineer stating that the plan would have no effect on the Ottumwa Sewage Treatment Plant, the Ottumwa Water Works, or the Des Moines River.

TABLE 6-6

CHEMICAL ANALYSES OF SOAP CREEK AND THE DES MOINES RIVER

Dissolved constituents and hardness in milligrams per liter. Analyses by State Hygienic Laboratory of Iowa

Sampling Point	Date Collected	Discharge (cfs)	Temperature F	Temperature C	Silica (SiO_2)	Iron (Fe) Soluble	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids	Hardness as $CaCO_3$	Phosphate (PO_4) Soluble	Organic Nitrogen	Chemical Oxygen Demand (C.O.D.)	Specific Conductance (Micromhos at 25 C)	pH
Des Moines River near Tracy	12-13-66	360	33	0.5	2.1	0.2	0.98	79	37	62	5.4	303	0	140	66	0.4	8.2	579	352	3.1	2.9	7.3	980	8.2
	4-10-67	2,260	62	16	6.3	.2	.05[a]	73	24	22	5.3	212	7.2	110	22	.4	4.1	430	282	.8	2.2	54	640	8.4
	6-12-67	28,700	72	22	9.9	1	.05[a]	73	24	22	5.3	212	7.2	110	22	.4	14	209	130	1.0	6.7	159	300	7.8
	9-12-67	581	62	16	1.6	.1	.05	62	26	31	4.7	171	29	97	31	.3	.4	407	264	1.1	2.3	39	580	8.8
Soap Creek near Floris	12-13-66		33	0.5	7.3	0.7	1.7	100	26	16	3.5	188	0	220	6.5	0.3	0.9	517	356	0.01[a]	0.20	10	710	7.4
	4-18-67	103	53	12	12	.2	.12	82	20	13	3.9	176	0	150	2.0	.3	1.9	424	288	.1	.56	26	620	8.0
	9-12-67	2.17	70	21	9.0	.5	1.2	91	20	14	2.8	152	0	210	4.0	.3	.4	476	312	.1[a]	.20	12	625	7.6
Des Moines River at Keosauqua	12-12-66	216	33	0.5	0.1	0.1	0.05[a]	69	37	68	5.6	251	1.3	160	74	0.4	8.2	591	326	1.5	2.9	82	975	8.5
	4-17-67	4,930	60	16	10	.2	.05[a]	51	14	12	4.8	127	0	82	9.0	.4	5.3	289	184	.5	3.3	99	420	8.0
	6-12-67	30,700	74	23	9.6	.1	.05[a]	42	9.2	7.4	3.9	121	0	36	4.0	.4	13	226	142	.7	8.7	247	325	7.8
	9-12-67	677	70	21	.6	.1	.05[a]	62	32	40	5.1	207	13	130	38	.4	.4	452	288	.4	.99	35	690	8.4

[a] Less than value shown.

Source: Coble, R. W. and J. V. Roberts, "The Water Resources of Southeast Iowa," Iowa Geological Survey Water Atlas Number 4, State of Iowa, 1971.

6.14 Alternatives Available to Reduce Demand

6.141 Advertising and Conservation Information Programs. Until recently, utilities have conducted advertising campaigns to increase the demand for electric power in their service areas. Promotional advertising has been discontinued and information is now being provided concerning energy conservation measures; e.g. better insulation, low temperatures in the winter, high temperatures in the summer, etc. In some instances, the use of electric space heating is being encouraged as a replacement for heating using fuels in short supply such as oil, natural gas, and propane.

6.1411 Iowa Southern Utilities Company and the other utility companies in Iowa have sponsored a variety of advertising and have participated in programs directed toward the conservation of electric energy by their customers. As an illustration, Table 6-7 lists energy conservation advertisements sponsored by ISU during 1975 and 1976.

6.1412 During 1976, Iowa utility companies also participated in the Iowa Community Betterment Programs administered by the Iowa Development Commission. The program had as its objectives the stimulation of greater interest, concern, and involvement for the improvement of the physical, environmental, social, cultural, and economic aspects of Iowa communities and their surrounding areas. Six Iowa communities undertook energy conservation projects, and Akron, Iowa was awarded the Commission's "Youth Involvement Award."[1] Their weatherization project involved the insulation of homes and roof repair.

6.142 Adjustment of Rate Schedules. It has been suggested that utilities increase their electric rates in such a manner as to encourage a reduction in use. In the past, utility rate structures have been designed to promote consumption of electricity by using the declining block rates. These rates reflect the declining average cost of furnishing additional killowatt hours of electrical energy to each customer. Only since attention has been focused on energy conservation have declining block rates been questioned.

6.1421 To discourage the use of electricity, possible actions include increasing block rates, peak load pricing, and flat rates. It is not known at what point consumers would significantly curtail their use of electricity rather than pay an increased price. Several state and federal government studies are being conducted to make such a determination.

6.1422 During August 1976, ISU advertisements advised customers that electricity consumers who used more than 800 kilowatt hours in a month during June, July, August, and September would be charged

Table 6-7

ENERGY CONSERVATION ADVERTISEMENTS SPONSORED BY IOWA SOUTHERN UTILITIES COMPANY DURING 1975-1976

Title	Publication Date
Heat Energy Dollar	January 1975
A Do-It-Yourself Kit To Save Energy & $ $ $	April 1975
How To Insulate Your Home Yourself[a]	April 1975
Switching To Electric Heat? We Can Help![a]	May 1975
Lets Talk About Your Natural Gas Service Bill	March 1976
Lets Talk About Your Electricity Bill	March 1976
What's Your Air Conditioner's E.Q?	May 1976
Don't Be Shocked By Your Electric Bill!	August 1976
Insulation To Keep In the Warm Air You've Paid For	September 1976

[a] Bill inserts

.4¢ per kWh more than the rate for other months. It was explained that the extra charge would help offset additional costs of serving higher summer loads and would encourage energy conservation.

6.1423 Many factors other than price, however, influence the demand for electric power. The future demand will be affected by the economy, the continued growth of industry, developing technology, and the attitude of the people. All the factors interact to establish the demand for electricity.

6.143 Load Staggering to Reduce Peak Demand. Load staggering involves the changing of the operational hours of industrial or commercial firms to reduce the daily peak load demand. Serious objections might develop from both workers and customers as a result of such a program. Such an adverse impact might occur that the feasibility of load staggering would be questionable.

6.144 More Efficient Utilization of Electrical Energy. There are a number of ways that electricity can be more efficiently used. Considerable efficiency can be achieved in space conditioning by improved insulation, the use of building materials with better insulation properties, and by using equipment which transfers or stores excess heat or cold. Energy saving building techniques can result in a reduction of as much as 25 per cent in electrical energy usage. In 1971, the Federal Housing Administration established insulation standards designed to reduce average residential heating losses by one-third. The demand for air-conditioning also is reduced as the result of greater insulation.

6.1441 Reduction in lighting levels also can result in decreased electrical energy consumption. Lighting accounts for about 24 per cent of all electricity sold nationally. Better design of lighting systems and the substitution of fluorescent for incandescent lights would help save electric energy.

6.1442 The development of more efficient household appliances would help conserve energy. At the present, more efficient air conditioners, refrigerators, freezers and various small appliances are being developed and marketed. It has been estimated that an improvement in average efficiency from 6 to 10 Btu/Watt-hr of room air conditioners could reduce peak demand nationally 58,000 MW by 1980.

6.145 Effectiveness of Efforts to Reduce Demand. Since the Arab oil embargo, growth in electric consumption has been at a reduced rate in the United States and in Iowa. The embargo apparently created a "conservation ethic" throughout the nation and price, publicity, and conservation programs have contributed to its continuance.

6.1451 As shown in Table 6-8, the average rate of growth for Iowa has been about 7 per cent per year through 1973 but declined dramatically in 1974, the year of the embargo. Preliminary 1975 data show consumption growing by 6 per cent; however, final revised data indicate that consumption will grow by 4 per cent. Since both growth rate values are below the 7 per cent average rate, indications are that voluntary conservation has continued.

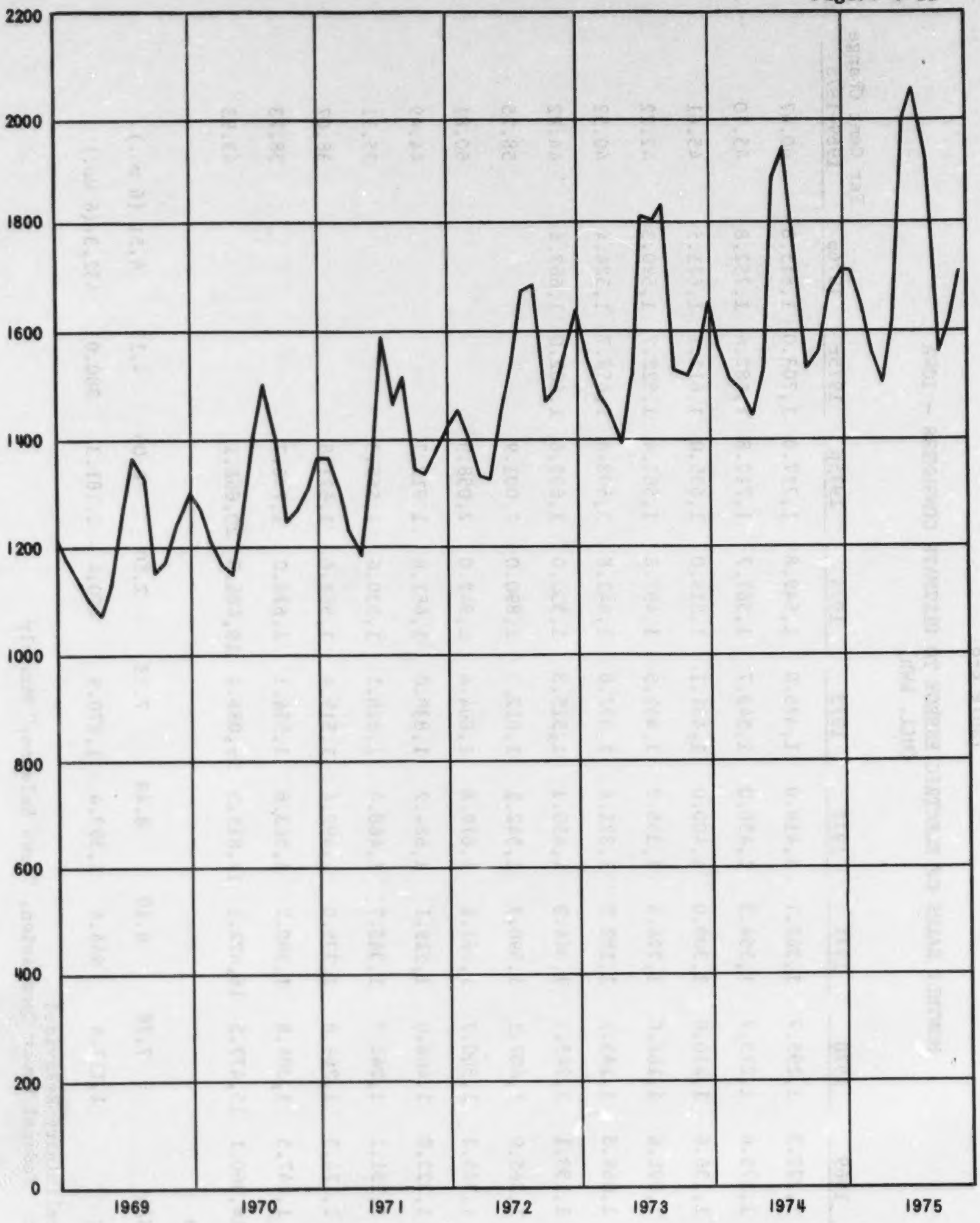
6.1452 The consumption of electric energy by ultimate consumers in Iowa is shown in Figure 6-8 for 1969 through 1975. It is apparent that peak consumption has grown at a greater rate than total consumption. Unfortunately, it is the peak demand that must be met by the utility companies. It appears that conservation results have been general in nature and there has been little or no effect in the areas of greatest need, peak demand.

Table 6-8

MONTHLY SALES OF ELECTRIC ENERGY TO ULTIMATE CONSUMERS - IOWA
(Mil. kWh)

	1969	1970	1971	1972	1973	1974	1975p	1975r	1976p	Per Cent Change 1969-1975
Jan.	1,222.3	1,295.7	1,367.1	1,418.0	1,628.0	1,649.8	1,717.0	1,703.0	1,815.8	40.47
Feb.	1,175.6	1,273.2	1,364.3	1,456.0	1,545.7	1,567.7	1,712.8	1,682.6	1,752.8	45.70
Mar.	1,136.6	1,210.8	1,309.0	1,400.0	1,481.1	1,518.0	1,655.0	1,611.1	1,671.5	45.61
Apr.	1,098.6	1,168.6	1,224.4	1,335.2	1,452.5	1,497.8	1,562.4	1,528.7	1,590.3	42.22
May	1,069.3	1,145.2	1,182.2	1,321.4	1,397.0	1,442.8	1,502.6	1,458.7	1,524.4	40.52
June	1,130.1	1,245.3	1,344.3	1,450.1	1,515.3	1,530.0	1,636.6	1,602.0	1,663.6	44.82
July	1,265.0	1,407.1	1,590.7	1,542.1	1,812.3	1,890.0	2,001.9			58.25
Aug.	1,365.2	1,500.7	1,461.6	1,679.8	1,804.4	1,942.0	2,058.9			50.81
Sept.	1,323.8	1,408.0	1,519.1	1,684.2	1,838.0	1,681.8	1,912.7			44.49
Oct.	1,151.1	1,242.7	1,343.7	1,468.4	1,528.1	1,530.6	1,555.3			35.11
Nov.	1,174.5	1,269.8	1,335.0	1,492.4	1,519.4	1,561.6	1,621.6			38.07
Dec.	1,247.5	1,304.8	1,380.2	1,563.6	1,554.1	1,674.0	1,730.7			38.73
Year	14,360.1	15,477.5	16,422.1	17,815.5	19,086.4	19,486.8	20,668.1			43.93
Change Per Cent	N/A	7.78	6.10	8.49	7.13	2.10	6.06	4.13	4.51 (6 mo.)	
Number		1,117.4	944.6	1,393.4	1,270.9	400.4	1,181.3	380.0	432.3 (6 mo.)	

p = Preliminary R=Revised
Source: Federal Power Commission, "News Release," Monthly



SOURCE: FEDERAL POWER COMMISSION, "NEWS RELEASE" MONTHLY.

CONSUMPTION OF ELECTRIC ENERGY BY ULTIMATE CONSUMERS-IOWA
(MIL. KWH)

VII RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.01 Short-Term Relationship. The production of electric power and the utilization of related resources over the expected 30-year life of the Ottumwa Generating Station is considered short-term use.

7.011 The short-term benefit of the Ottumwa Generating Station will be a capacity adequate to meet the electric power requirements of the owner utilities, Mid-Continent Area Power Pool Members and Mid-Continent Area Reliability Coordination Agreement Region. The additional electrical energy will be available throughout the service area to residential users, commerce, industry, agriculture, public service, and recreation. The added capacity of Ottumwa Station will provide greater system reliability and reduce the probability of system disturbances.

7.012 There will be other short-term benefits associated with the construction phase. These benefits will include the creation of new jobs, the expansion of local commerce and related secondary economic activities, and a growth in the local tax base. Such beneficial impacts will result from the establishment of the new facility as well as from increased payrolls and business activity.

7.013 Some adverse, short-term impacts will be associated with the construction activities of the generating facility. There will be some unavoidable contributions of turbidity of the Des Moines River during the construction of the intake structure, increased noise levels, and some decrease in air quality. These impacts are discussed in Section 4.01, page IV-1.

7.02 Long-Term Relationship. Long-term productivity refers to the resource development potential which remains after the life span of the Ottumwa Generating Station.

7.021 The long-term maintenance of productivity potential should be preserved in the areas of water quality of the Des Moines River, aquatic biota, and ambient air quality since the Ottumwa Generating Station must comply with stringent federal and state regulations. The maintenance of these resources has been discussed in previous chapters of this report.

7.022 The most significant long-term effect of the proposed project would be an increase in human productivity stimulated by the availability of additional electric power. This may result in increased development in the service areas of the owner utilities.

VIII IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

8.01 General. The construction and operation of the Ottumwa Station would result in the irreversible or irretrievable commitment of some natural resources. These resources either would be expanded or altered to the extent that they could not be restored for later use.

8.02 Fuel. The fossil fuel used to operate Ottumwa Station will be the principal irreversible commitment of natural resources. From 1.9 to 2.7 million tons of coal will be used annually as well as approximately 250,000 gallons of fuel oil for initial light-off and flame stabilization. During the estimated 30-year life of the generating station from 57 to 81 million tons of coal and about 7,500,000 gallons of oil will be burned for fuel.

8.03 Land. Much of the land resources presently used for agricultural purposes will not be available during the 30-year expected life of the generating facility. Some of the land on the 795 acre site, however, will be leased for farming activities while the generating station is in operation when possible.

8.04 Water. Water withdrawn from the Des Moines River for condenser cooling and other plant uses will be a consumptive use. Water withdrawal from the river will be at an estimated rate of 11,091,000 gallons per day (about 17 cfs) or 4,061,355,000 gallons per year for the maximum operating condition, and 7,834,000 gallons per day (approximately 12 cfs) or 2,859,410,000 gallons per year for the average operating condition. Over the 30-year life of the generating station a calculated amount of 121,840,650,000 gallons will be withdrawn for maximum operating conditions, and 85,782,300,000 gallons will be withdrawn for average operating conditions. These calculations are based on plant operations for 365 days a year and represent maximum values. Actual water usage will be less. The average and maximum operating conditions are defined in Section 1.044 of this report. The amount of water discharged back to the Des Moines River is estimated to be 889,000 gallons per day or 324,485,000 gallons per year at maximum operating conditions, and 700,000 gallons per day or 255,500,000 gallons per year at average conditions.

8.05 Biological. Vegetation removed for construction would be irretrievably lost, although grasses, shrubs, and trees would eventually become re-established if the structures were removed. Small aquatic organisms present in the river water withdrawn for plant use would be lost. Some other larger organisms may be impinged and injured or eliminated. Aquatic organisms, however, are a renewable resource in that they would be eventually replaced. Phytoplankton and zooplankton would be replaced in a matter of days, while benthic fauna and fish fauna would be replaced over a period of months and years.

8.06 Energy. Although calculating the quantity of materials expended in the construction of OGS is indicative of the direct commitments of material resources, the calculation of the indirect commitments, such as the energy needed to produce the steel that is used to make the machinery which forges and fabricates the steel used in OGS, is also necessary. The energy resources associated in manufacturing these materials are important since the direct recovery of this energy in its natural form cannot be accomplished.

8.061 Several methods have been devised in computing the indirect energy commitments and account for the energy per dollar used in manufacturing materials for construction. The method used for this study was devised by Rombough and Koen[1] in either calculation of the total energy investment to construction of a 1000 MW coal-fired power plant[2]. Their approach, which considers all indirect as well as direct energy commitments, is formulated on the basis of an average energy/cost ratio for the United States. This ratio is determined by dividing the total energy consumed in the U.S. in a given year by the gross national product of the same year. Multiplying this average energy/cost ratio times the cost of construction (in dollars) results in a rough estimate of the total construction energy cost.

8.062 Adapting this approach to OGS (727 MW unit) at an estimated construction cost of $250,000,000, the resulting total energy commitment to construction, based on 1972 average energy/cost ratio of 62,413 Btu/dollar[3], is 0.15×10^{14} Btu. Adding the total energy committed to construction to the estimated 15.28×10^{14} Btu expended in OGS lifetime plant operation, the result is a gross value of 15.44×10^{14} Btu consumed. Subtracting 5.21×10^{14} Btu of electrical energy produced in the plant's lifetime from the gross value, a net energy expenditure of 10.22×10^{14} Btu is obtained.

8.063 Therefore, during a 30-year period of station operation at 80 per cent capacity, the energy committed to construction is 1.0 per cent of the total energy expenditure or 2.9 per cent of its total electric generation. The net energy output of the plant is 34 per cent of the total energy expenditure (construction plus operation).

8.07 Other Commitments. Construction materials would be comprised primarily of concrete, steel, aluminum, copper, zinc, lead, lumber, insulation, and asphalt. These materials essentially would be unavailable for further use. Some materials used to construct transmission towers and lines could be utilized for other purposes.

8.071 **The electricity produced by the facility would be a man-made resource which, once used by man, would be irretrievable.**

REFERENCES

1. Rombough, Charles T., and Koen, Billy V., "Total Energy Investment in Nuclear Power Plants," Nuclear Technology, Vol. 26, Number 1, pp. 5-11, (May 1975).

2. "1000 MW(e) Central Station Power Plants Investment Cost Study," Vol. III, "Coal-Fired Fossil Plant," United Engineers and Constructors, Inc., U.S. Atomic Energy Commission, Washington, D.C., (1972).

3. "Statistical Abstract of the United States - 1974," U.S. Department of Commerce, Bureau of the Census, Washington, D.C., (1974).

IX COORDINATION AND COMMENT AND RESPONSE

9.01 Consultants. Engineering data and an evaluation of various probable impacts that would result from the construction and operation of the Ottumwa Generating Station in Wapello County, Iowa were prepared by Black & Veatch Consulting Engineers, Kansas City, Missouri. The following expert consultants contributed to the environmental studies as indicated.

Air Quality Analyses	Dr. C.W. Langston, Mr. W.D. Hughes Langston Laboratories, Inc., Leawood, Kansas.
Archaeological Studies	Mr. D.C. Anderson, Iowa State Archaeologist, Iowa City, Iowa. Mr. M.S. Weichman, Environmental Research Center, Iowa City, Iowa.
Aquatic Studies	Dr. D.B. McDonald, Iowa Institute of Hydraulic Research, University of Iowa, Iowa City, Iowa.
Benthic Studies	Dr. W.B. Merkley Drake University, Des Moines, Iowa.
Terrestrial Studies	Dr. D.C. Glenn-Lewin Iowa State University, Ames, Iowa.

9.02 Government Agencies and Officials. The following federal, state, county and local agencies and individuals have been notified by the applicant and its contractor concerning the proposed plans to construct and operate the Ottumwa Generating Station.

*Iowa Department of Environmental Quality
3920 Delaware Avenue
Des Moines, Iowa

*Iowa Natural Resources Council
Grimes Building
Des Moines, Iowa

---

*Indicates those agencies to which applicant and contractor have held meetings.

*Iowa Conservation Commission
4th and Walnut
Des Moines, Iowa

Iowa Commerce Commission
4th and Walnut
Des Moines, Iowa

Commissioner of Public Health
Iowa State Health Department
Lucas State Office Building
Des Moines, Iowa

*Iowa State Department of Health
State Hygenic Laboratory
Iowa City, Iowa

Soil Conservation Committee
Grimes Building
Des Moines, Iowa

*Iowa State Archaeologist
129 S. Capitol Street
Iowa City, Iowa

Department of Transportation
Ames, Iowa

Iowa Historical Society
Iowa City, Iowa

*Office for Planning and Programming
Capitol Building
Des Moines, Iowa

*Iowa Development Commission
250 Jeweff Building
Des Moines, Iowa

*Center for Industrial Research and Service
Iowa State University
Ames, Iowa

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*Indicates those agencies to which applicant and contractor have held meetings.

*Iowa State Geologist
Iowa Geological Survey
Iowa City, Iowa

*Mr. Bruce Bullamore
Planning Director
Area XV Regional Planning Commission
Ottumwa Industrial Airport
Ottumwa, Iowa

*Mr. Dale Euhling
County Agent
County Extension Service
211 E. Second Street
Ottumwa, Iowa

*Mr. Jay Pulis
Planning Director
City Hall
Ottumwa, Iowa

*Mr. H.S. (Biff) Byrum
Ottumwa Area Development Corporation
Hotel Ottumwa Building
Ottumwa, Iowa 52501

Wapello County Board of Supervisors
Wapello County Court House
Ottumwa, Iowa

*Mr. Hugh Stufflebeam
Mayor
City Hall
Ottumwa, Iowa

*Mr. Marvin Ferdig
Mayor
Chillicothe, Iowa

*U.S. Corps of Engineers
Rock Island District Office
Rock Island, Illinois

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*Indicates those agencies to which applicant and contractor have held meetings.

9.03 Coordination Meetings. Coordination meetings by the applicant or the applicant's consultants have been held with the following agencies.

AGENCY	DATE
U.S. Corps of Engineers Rock Island District Rock Island, Illinois	January 16, 1975; March 10, 1975; June 4, 1975
Iowa Natural Resources Council Des Moines, Iowa	April 3, 1975; June 17, 1975; December 10, 1975
Iowa Conservation Commission Des Moines, Iowa	April 7, 1975
Center for Industrial Research and Service, Iowa State Univ. Ames, Iowa	April 8, 1975
Iowa Institute of Hydraulic Research, University of Iowa, Iowa City, Iowa	April 9, 1975
Iowa State Hygenic Laboratory Iowa City, Iowa	April 9, 1975
U.S. Geological Survey Iowa City, Iowa	April 9, 1975
Iowa Geological Survey Iowa City, Iowa	April 9, 1975
U.S. Soil Conservation Service Ottumwa, Iowa	April 10, 1975
County Agent, Wapello County Extension Office Ottumwa, Iowa	April 10, 1975

AGENCY	DATE
State Historical Department of Iowa, Division of Historical Preservation Iowa City, Iowa	July 22, 1975

On June 23, 1976 the U.S. Environmental Protection Agency, with the support of Iowa Southern Utilities and their contractor, Black & Veatch Consulting Engineers held a public information meeting for the dual purpose of describing the intent and current status of the Ottumwa EIS, and of gaining early public input.

9.04 Permit Applications. Applications for the following permits have been submitted or will be submitted in the future.

AGENCY	PERMIT	STATUS (December 1976)
U.S. Army Corps of Engineers	Permit to work in Navigable Waters	Application filed October 31, 1975
U.S. Environmental Protection Agency	NPDES Permit	Application filed October 31, 1975
Federal Aviation Administration	Determination of no hazard to air navigation	Determination made July 30, 1976
Iowa Department of Environmental Quality	Water Quality Certification	To be submitted
	Permit to construct wastewater disposal system	To be submitted
	Solid waste disposal area permit	To be submitted

AGENCY	PERMIT	STATUS (July 1976)
	Permit to install air pollution equipment	Specifications for precipitator, steam generator, coal-handling system, chimney submitted
	Operating permit	No action
Iowa Natural Resources Council	Permit to divert, store, or withdraw water	Application filed December 15, 1975
	Permit to construct facilities in flood plain	Tentatively approved January 6, 1976
Iowa Commerce Commission	Franchise to construct, operate and maintain transmission line	To be submitted
Iowa State Department of Health	Approval of sewage treatment plant plans and specifications	To be submitted
Iowa Conservation Commission	Construction permit	Approved May 21, 1976
U.S. Environmental Protection Agency	Approval to construct in compliance with Prevention of Significant Deterioration Regulations	Approved December 1, 1976

APPENDIX A

ARCHAEOLOGICAL INVESTIGATIONS IN THE PROPOSED AREA OF THE OTTUMWA GENERATING STATION CHILLICOTHE, IOWA

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ACKNOWLEDGEMENTS

Archaeological sites 13WP13, 13WP14, 13WP22, 13WP25 and 13WP85 were tested in the spring of 1975. Richard G. Slattery of the Office of State Archaeologist was field director. He was assisted by Arthur E. Hoppin, John Sanderson Stevens II, Lawrence Ryan and at times by Don G. Spears. Site mapping was assisted at one point by John Hotopp. Office of State Archaeologist and Derrick J. Marcucci, anthropology student, University of Iowa. After field work was completed, the task of researching, describing and interpreting the sites and materials was undertaken by the author.

Thanks are due to the many people who contributed to this report: Duane C. Anderson, Joseph A. Tiffany, and Richard G. Slattery, Office of State Archaeologist; Todd Mozingo and Lowell Soike, Division of Historic Preservation; Joyce Giaquinta and Alan Schroder, Division of the State Historical Society of Iowa; David M. Gradwohl and Nancy Osborn, Department of Anthropology, Iowa State University; Carroll Truitt of the firm of McElroy, Truitt and Truitt, Ottumwa; Don G. Spears and Lawrence Ryan, Southeast Chapter, Iowa Archeological Society; Anton Till, Division of Historic Preservation, Field Archaeologist; Dennis Davis and Thomas Armitage, Ottumwa Public Library; W. Sinclair Venables, Wapello County Historical Society, Ottumwa; Vivian Jones, Eddyville; and Mrs. P. Darner, Ottumwa.

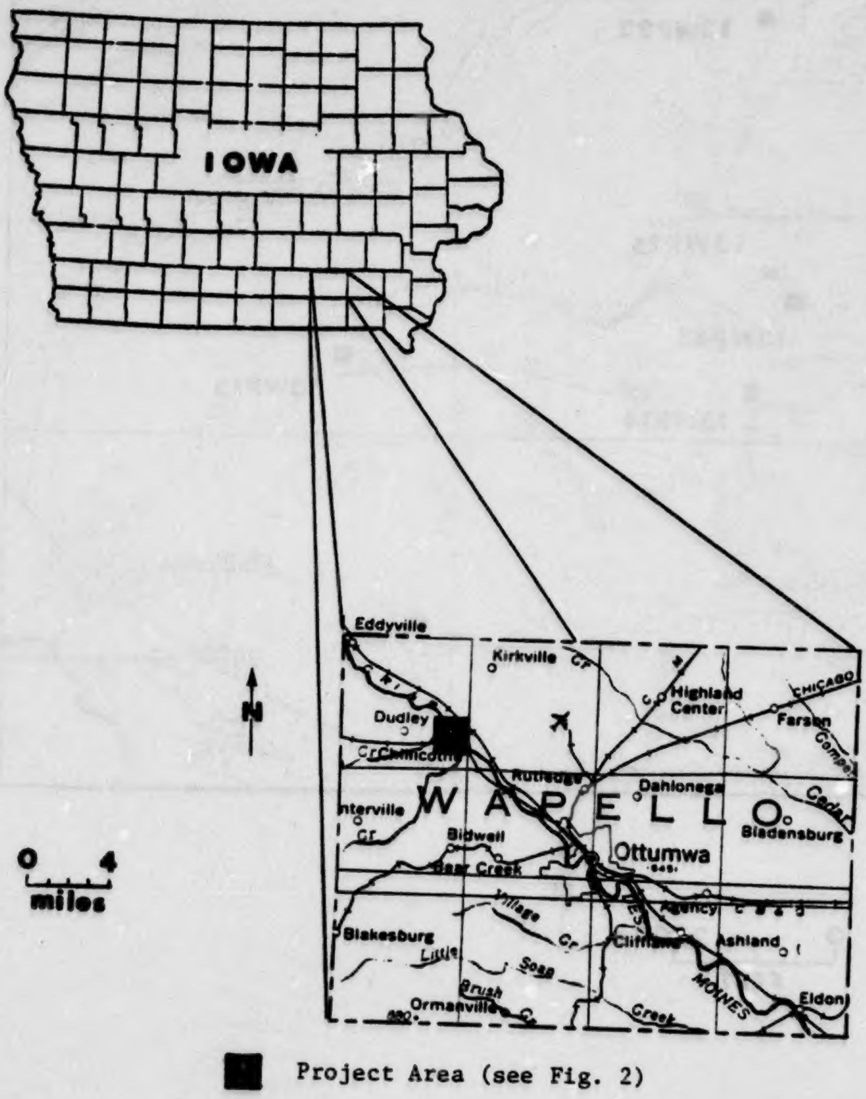
Special notes of thanks are extended to Loren N. Horton, Division of the State Historical Society of Iowa; Holmes A. Semken, Geology Department, The University of Iowa; Margaret Hotopp, Anthropology Department, The University of Iowa; Katie Fogleson, Ottumwa; and to Mary W. Slattery and Betty Horner, Office of the State Archaeologist of Iowa.

INTRODUCTION

The Office of State Archaeologist, The University of Iowa, entered into agreement with the firm of Black & Veatch, representing Iowa Southern Utilities (ISU), for the purpose of conducting archaeological investigations in the vicinity of the ISU Generating Station under construction near Chillicothe, Iowa (Fig. 1).

Phase I surface reconaissance survey by Weichman (1975) revealed thirteen archaeological sites in the project area. The Office of State Archaeologist was subsequently contracted to provide Phase II testing and evaluation and Phase III salvage. The results of Phase II testing and evaluation were submitted in a 1975 report (Slattery and Tandarich 1975) at which time recommendations concerning further work (Phase III) were made. Sites 13WP13, 13WP14, 13WP22 and 13WP25 were recommended for Phase III archaeological work. During the Phase III operations conducted in March and April, 1976, an additional prehistoric site, 13WP85, was discovered and investigated. This report will describe the findings of Phase III archaeological work at the five sites mentioned above.

The locations and topographic situation of the five sites to be discussed in this report are shown on Figs. 2-4. Sites 13WP13, 13WP14 and 13WP85 are prehistoric, while sites 13WP22 and 13WP25 are historic Euro-American.



Project Area (see Fig. 2)

Figure 1. Location of Project Area within Wapello County, Iowa. USGS Iowa Base Map, scale 1:500,000.

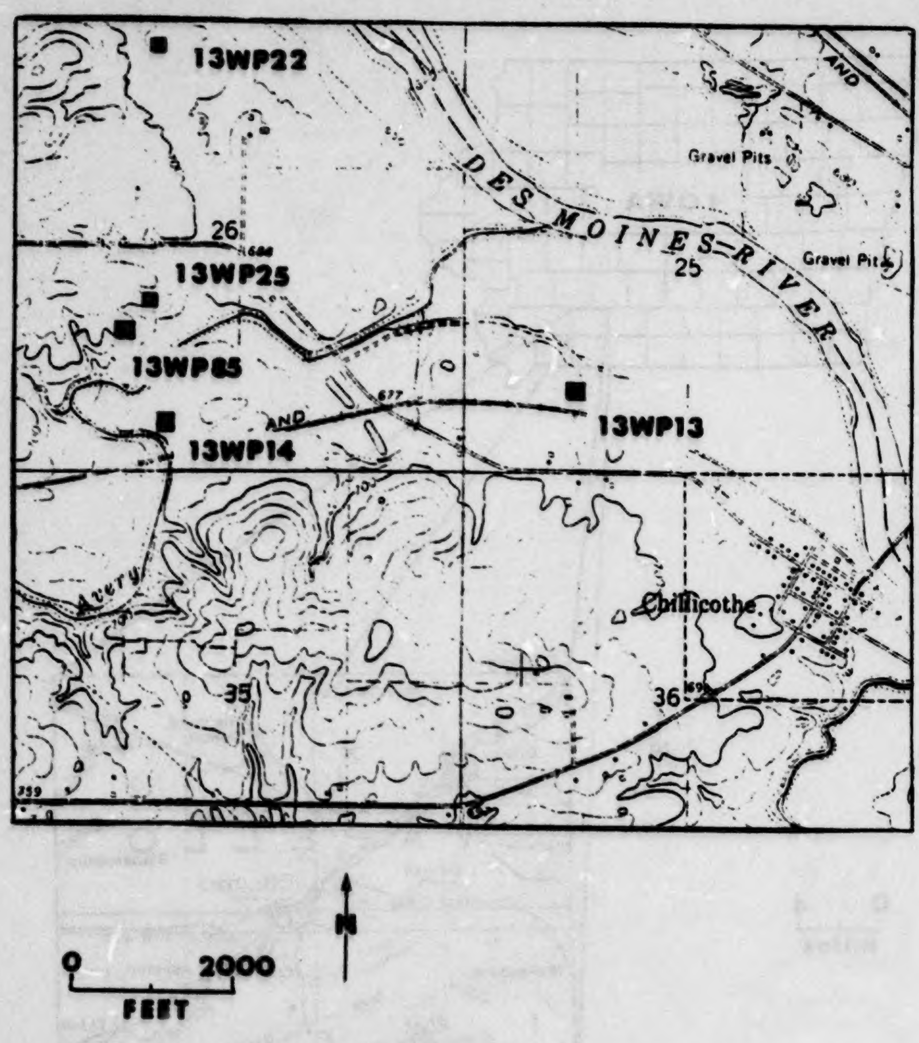


Figure 2. Location of sites discussed within this report. USGS Chillicothe Quadrangle Map, scale 1:24,000.

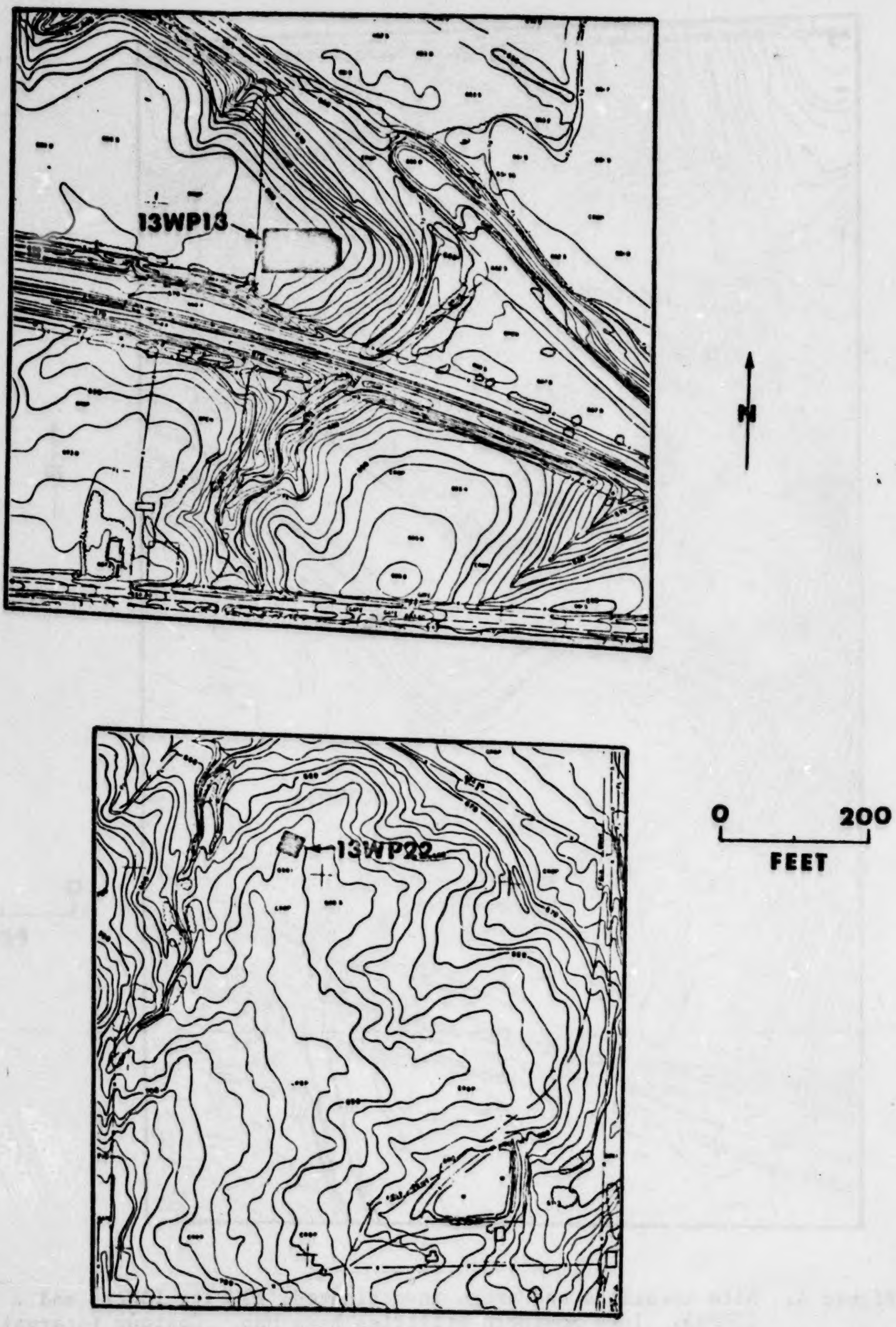


Figure 3. Site locations and areas investigated, 13WP13 (above) and 13WP22 (below). Iowa Southern Utilities Base Map. Contour interval: 2 feet.

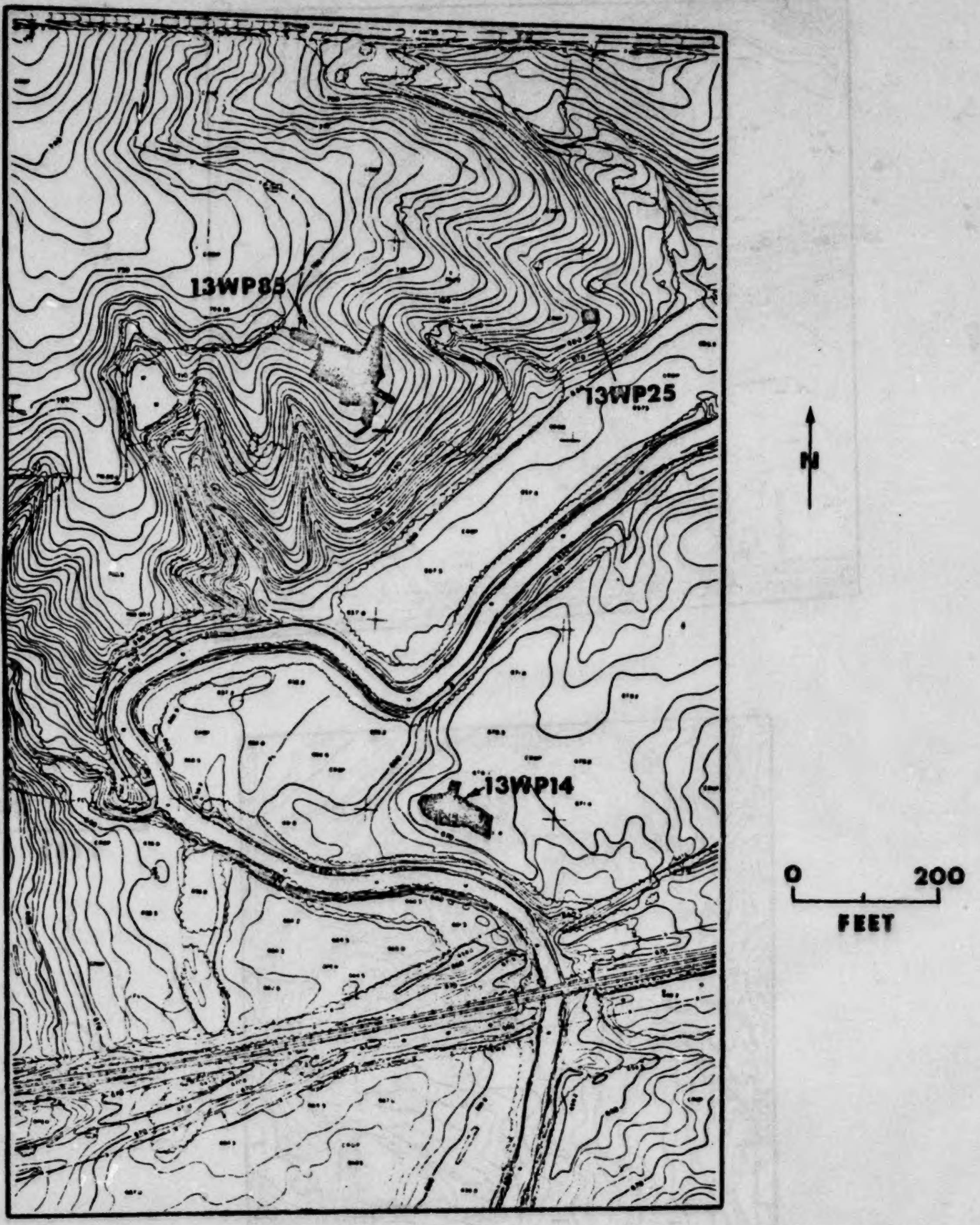


Figure 4. Site locations and areas investigated, 13WP14, 13WP25 and 13WP85. Iowa Southern Utilities Base Map. Contour interval: 2 feet.

Prior to the initiation of Phase III activities, plans were made to clear all or part of the plowzone on each site in an effort to determine if subsurface features were present. In so doing, an attempt was made to recover a material culture inventory sufficient to allow for a determination of the cultural affiliation and use of each of the sites. Depending on the results of testing, the field supervisor was prepared to investigate structures, activity areas, refuse deposits, or other pertinent features. Specific methods and techniques employed on each site are described in context within the body of this report.

Although the prehistoric sites were known to be shallow and heavily disturbed by cultivation, they were believed to be campsites. This interpretation was borne out by the Phase III investigations. However, few diagnostic artifacts were found and none of the features investigated yielded climatic or environmental information. As a result, this report is speculative in terms of the interpretation of the prehistoric sites investigated.

In the case of the historic sites, particular attention was given to the site plan following the research strategy outlined by Price and Price (1976 ms). This proved to be a useful approach since one of the historic sites investigated was found to be a farmstead and the other is believed to represent a portable steam saw mill.

During the laboratory phase the research strategy for dealing with the historic sites was refined with the assistance of Loren N. Horton, State Historical Society of Iowa. In order to ascertain the dates of construction of the structures, their possible occupants and the length of occupation, a list of original historical sources was prepared and entries were ranked in order of priority (Table 1). The results of this research are presented in this report.

Table 1: Priority Ranking of Historical Research Sources

Rank	Location	Source Depository	Sources
1	Iowa City	State Hist. Soc.	Historical Map File, atlases Geol. Survey Ann. Rept., Maps
	Ames	DOT I.S.U. Map Coll.	Road Records and Maps W.P.A. Maps
2	Des Moines	Sect'y of State	Government Land Office Surveys
	Ottumwa	Wapello Co. Recorder of Deeds McElroy, Truitt & Truitt (abstractors)	Land Transfer Books, Plats
3	Ottumwa	Wapello Co. Board of Supervisors.	Minutes of Board Meetings Records for cemeteries, bridges, roads
4	Iowa City	State Hist. Soc.	County histories, state histories, Census
	Ottumwa	Public Library	Centennial histories of nearby towns, city directories
		Wapello Co. Hist. Soc.	Oral tradition & misc. info.
5	Ottumwa	Public Library	Newspaper accounts in scrapbooks, microfilm
6	Ottumwa	County Treasurer &/or Recorder's Office	Tax rolls 1857
7	Iowa City	Univ. of Iowa Libraries, Gov. Docs.	Soil survey maps (old)
8	Iowa City	State Hist. Soc.	Photograph coll., mss. catalog, vertical file, post card coll.
		University of Iowa Libraries, Special Coll.	W.P.A. Records, archival material
	Des Moines	Division of Historical Museum and Archives	Manuscripts
	Ottumwa	Public Library	J.P. Eddy's Diary

Source: Loren N. Horton (personal communication) and author's research.

THE PREHISTORIC SITES
13WP13, 13WP14 and 13WP85

Three prehistoric sites have been extensively examined: 13WP13, 13WP14 and 13WP85. The locations of these three sites are shown on Figs. 2-4.

Site Plans

Portions of all three sites were scraped to the subsoil by a roadgrader during Phase II operations. During Phase III the entire site areas were cleared allowing a full view of soil color changes and subsurface features, and enabling a representative collection of artifactual items to be made.

All exposed features on the prehistoric sites were surveyed and mapped *in situ* with a transit. The maps so produced are displayed on Figs. 5, 6 and 7.

13WP13

Five hearths containing fire cracked rocks were uncovered (Fig. 5). Although the soil surrounding these rock concentrations was not burned, many of the stones were. Of a total sample of 38 rocks recovered from these concentrations 50% were burned (see Table 3, Miscellaneous Unworked Material). An ash layer and two areas of charcoal were also observed (Fig. 5).

13WP14

Six probable post molds were recognized on the site (Fig. 6). No concentrations of fire-cracked rock or hearths were observed as on 13WP13. There appeared to be an activity area located around post 2 consisting of: 1 piece of worked limestone, 1 hematite core fragment, 2 heamtite waste flakes, 1 chert biface fragment (12)*, 2 chert waste flakes (1), 1 chert waste flake (14) and 2 chert core fragments (5). Four projectile points, one knife and one celt were also mapped on the site (Fig. 6).

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*Numbers in parentheses refer to lithic color categories, see section on *Material Culture Inventory*.

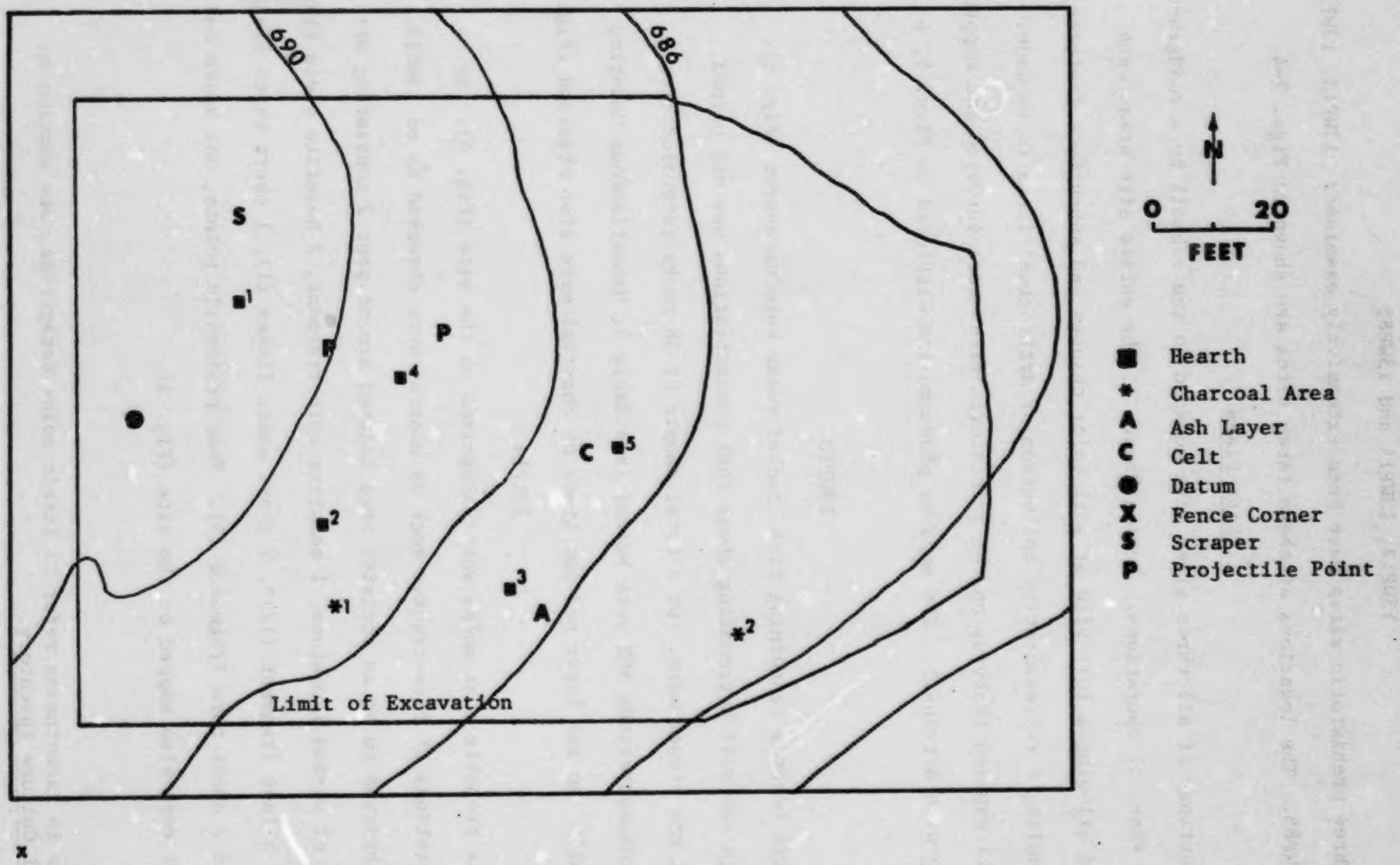


Figure 5. Site Plan, 13WP13.
Source: Slattery (1976c ms.)

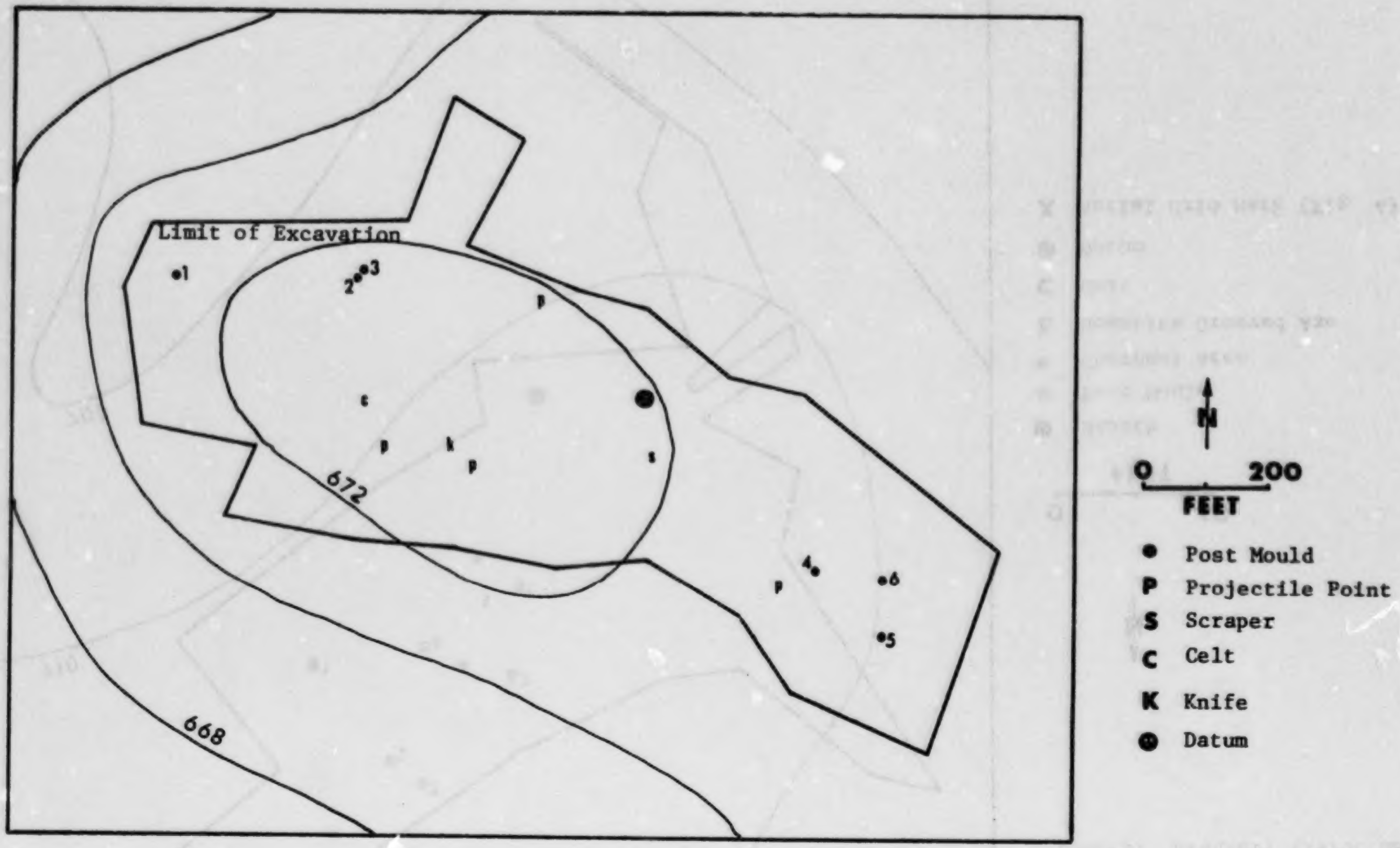
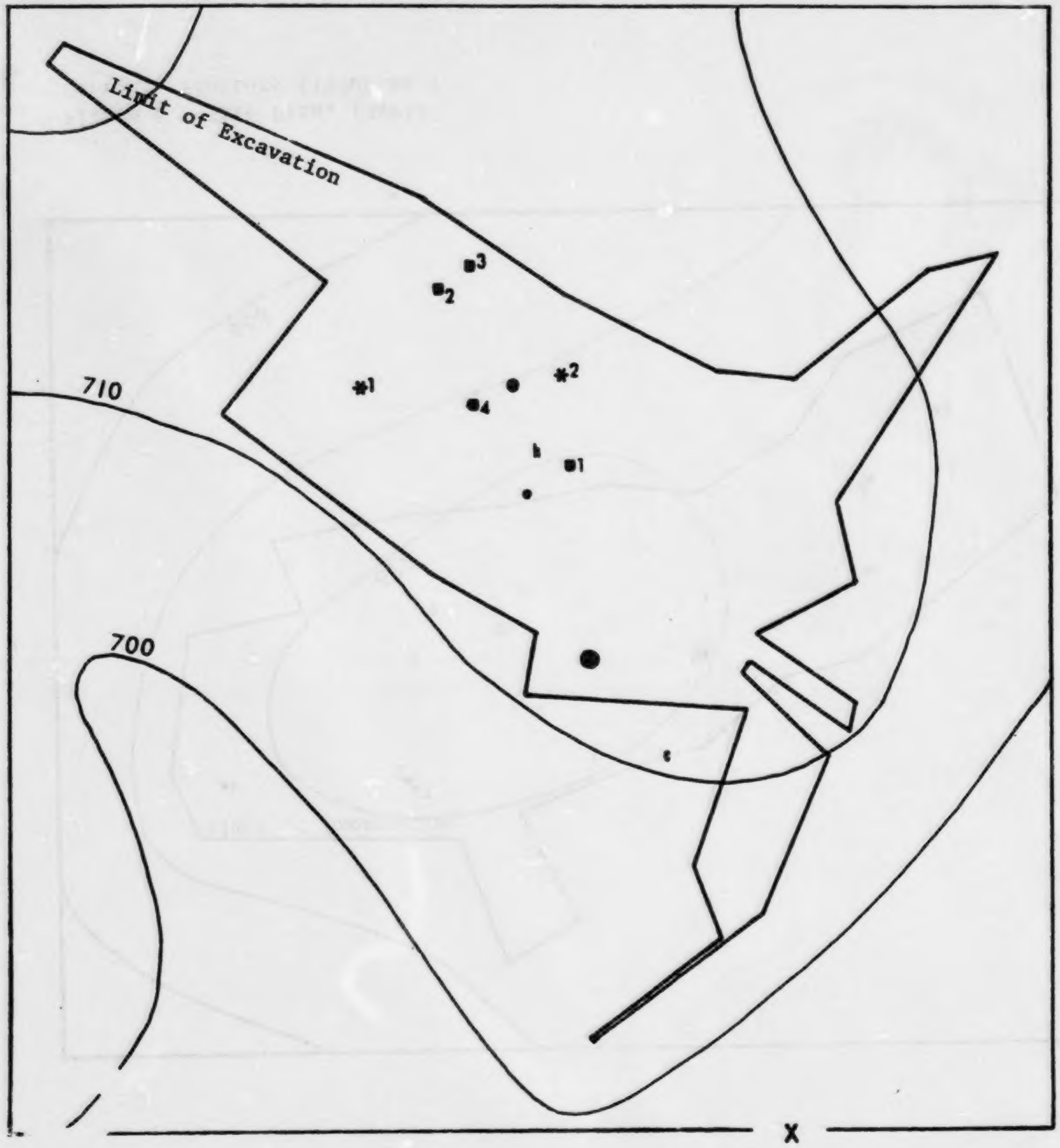


Figure 6. Site Plan, 13WP14.
Source: Slattery (1976c ms.)

Figure 7. Site Plan, 13WP85.
Source: Slattery (1976c ms.)



13WP85

Four hearths consisting of fire cracked and burned rock and earth were mapped (Fig. 7). Samples of material from three of the hearths were brought to the laboratory for identification (Table 2).

Table 2: Identification of Hearth Materials from 13WP85

Fragment Type	Hearth 1		Hearth 2		Hearth 3	
	unburned	burned	unburned	burned	unburned	burned
sandstone		24		7		2
siltstone		7	9	3		34
granite				7		

Source: R. S. Rhodes, personal communication.

Hearth 2 had a chipping area one foot from center on the northwest side. "Thirty four waste flakes were found in a concentrated area of 6 x 6 ins. including five waste flakes. . . on the east side of the hearth" (Slattery 1976 ms:13). In addition, two areas of charcoal and two apparent post molds were located (Fig. 7).

Material Culture Inventory

In order to analyze and inventory lithic materials from the three prehistoric sites, a number of categories were established based largely on color (cf. Anderson 1973). The inadequacy of this method is recognized. Geologic descriptors would be more useful than color, e.g., structure, fracture, texture, fossil and other inclusions, etc., for analyzing chert types. For gross description in this report, color will serve as a means to compare the lithics collected from the sites. Color descriptions were determined from the Rock Color Chart (Rock Color Chart Committee 1963).

1. Dark reddish brown (10 R 3/4) chert
2. Pale reddish brown (10 R 5/4) to moderate reddish orange (10 R 6/6) chert
3. Light brown (5 YR 6/4) to pale yellowish brown (10 YR 6/2) chert
4. Pale yellowish brown (10 YR 6/2) to grayish orange (10 YR 7/4) chert
5. Light olive gray (5 Y 6/1) to olive gray (5 Y 4/1) chert
6. Medium gray (N5) to brownish gray (5 YR 4/1) chert.
7. Medium gray (N5) to brownish gray (5YR 4/1) (as category 6) to grayish red (5 R 4/2).
8. Medium bluish gray (5 B 5/1) chert.
9. Medium bluish gray (5 B 5/1) to grayish red (5 R 4/2) chert
10. Very light gray (N8) to light bluish gray (5 B 7/1) chert.
11. Very light gray (N 8) to light bluish gray (5 B 7/1); to pale red (10 R 6/2) chert.
12. Very pale orange (10 YR 8/2) chert.
13. Very pale orange (10 YR 8/2) to grayish orange (10 YR 7/4) chert.
14. White (N9) chert.
15. Pale pink (5 RP 8/2) chert.
16. Multicolor speckled chert.
17. Multicolor banded chert.

18. **Very light gray (N8) to light gray (N7) chert.**

19. **Pale yellowish brown (10 YR 6/2) speckled chalcedony?**

20. **Pale red (10 R 6/2) to moderate reddish orange (10 R 6/6) quartzite.**

21. **Vein (cloudy) white (N9) quartz.**

22. **Clear quartz.**

23. **Multicolor quartz.**

24. **Light olive gray (5Y 6/1) chalcedony.**

25. **Pale reddish brown (10 R 5/4) chalcedony.**

LITHICS

Several diagnostic chipped stone artifacts were recovered from the prehistoric sites. This material is listed below and illustrated where appropriate. Inspection has been used to classify the artifacts into particular traditions. The main reference utilized for this study is White (1968). Artifacts recovered during Phase II activities are described and illustrated by Slattery and Tandarich (1975:5-9, 44).

13WP13

Side notched projectile point base, chert category 11, probable Ansell constricted-stemmed type(White 1968:Fig. 32-4), Late Hopewell chronology. A.D.300.-A.D.650 in Illinois. (Ibid.:14, 121). (Fig. 8A).

End scraper, chert category 12. (Fig. 8).

Hematite celt fragment. (Fig.8c).

Projectile point resharpened into a scraper, chert category 16, probably originally a Gibson notched (White 1968:Fig.32-3), Early to Middle Hopewell chronology in Illinois, 200 B.C.-A.D.300 (Ibid.: 14, 121). (Fig. 8).

13WP14

Point base, chert category 10, probable micro-Dickson type (White 1968:Fig.62-2), Late Middle Woodland (Hopewellian) chronology in Illinois, A.D. 300-600 (Ibid.:14,162). (Fig. 9A).

End scraper, chert category 14. (Fig. 9B).

Point base, chert category 4, resembles a subtriangular stemmed point discussed by White (1968:Fig.31-8), appears to be contemporaneous with Gibson and other Early to Middle Hopewell point types in Illinois, i.e., 200 B.C.-A.D.300 (Ibid.:14, 121). (Fig. 9C).

Partial side-notched point base, chert category 6, not enough of the point present to classify. (Fig. 9D).

Partial point blade and contracting stem base, chert category 16, resembles a Waubesa (Adena) though the stem is much shorter than typical Waubesa point, chronology is probably Early Woodland, 500-250 B.C. (White 1968:Fig.65). (Fig.9E).

Lanceolate point, chert category 10, edge ground on one side, resembles a Nebo Hill variant (Chapman 1975: Figure 604, lower row, third from right). Early Archaic in chronology 700 B.C.-5000 B.C. (Chapman 1975:27). (Fig 9F).

Hematite celt fragment. (Fig. 8E).

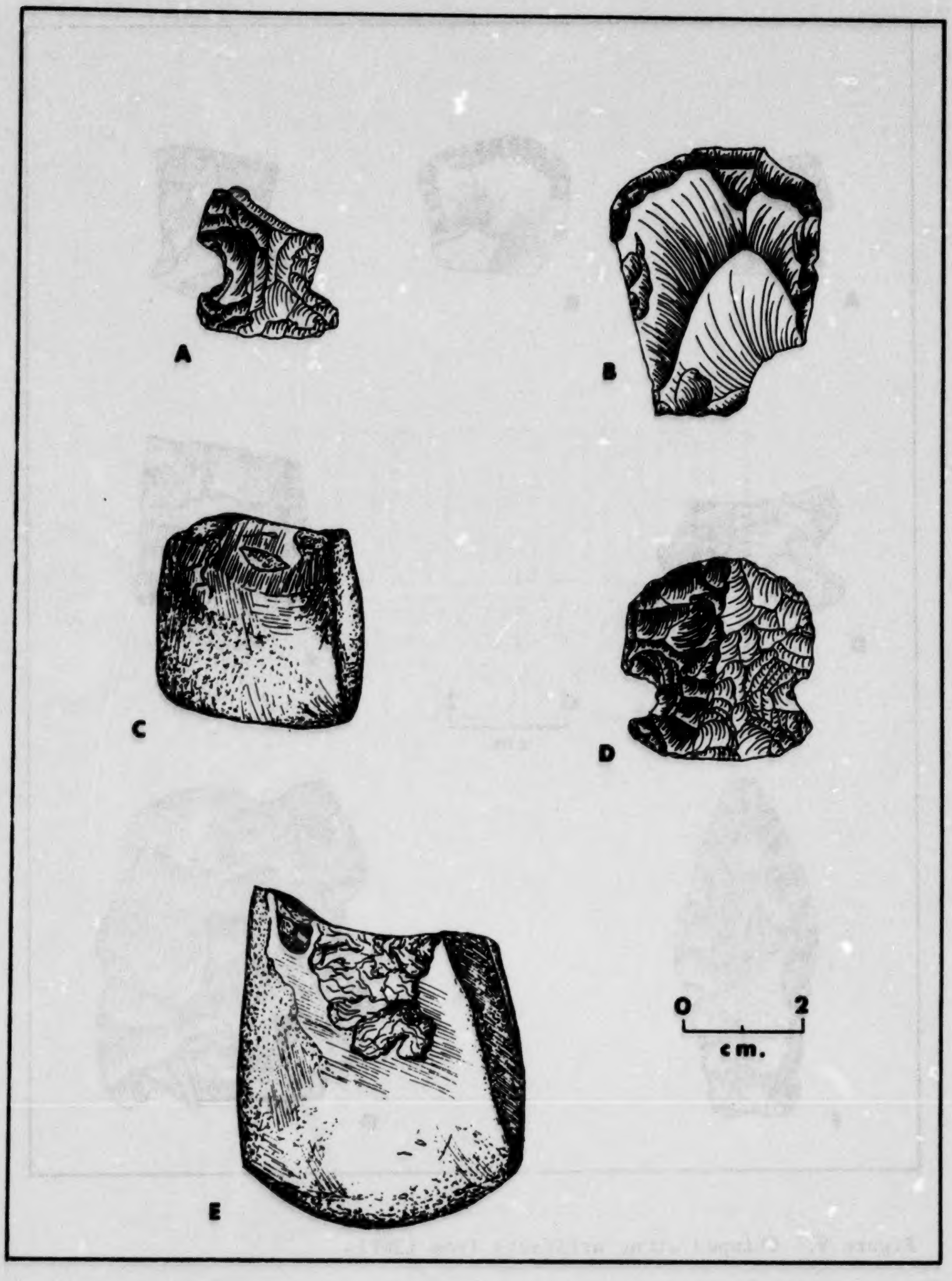


Figure 8. Chipped and ground stone artifacts from 13WP13 and 13WP14. A-D, 13WP13; E, 13WP14.

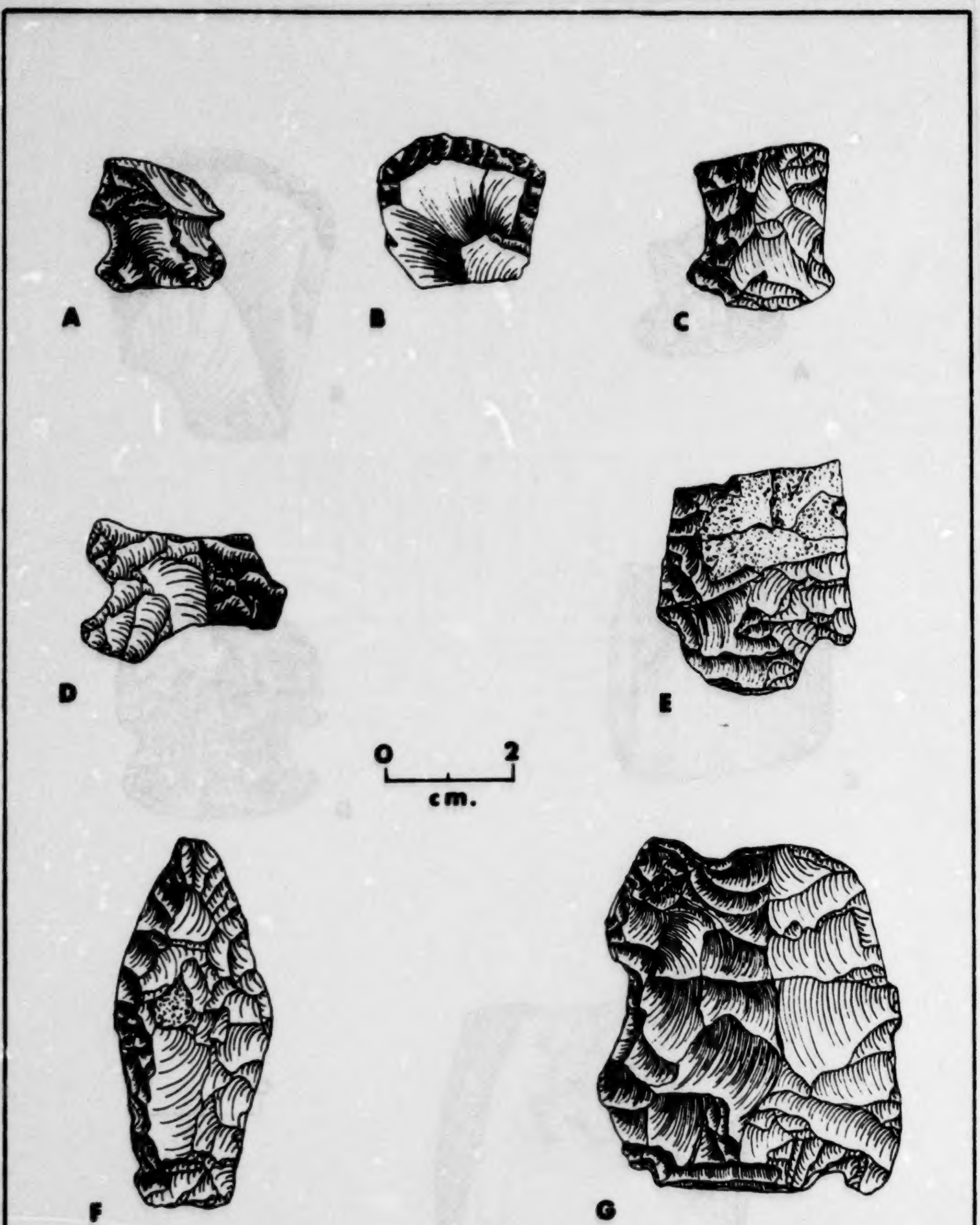


Figure 9. Chipped stone artifacts from 13WP14.

13WP85

Subtriangular stemmed point base, chert category 16, very similar in form and chronology to subtriangular point from 13WP14 (see above). (Fig. 10A).

Subtriangular point, chert category 12, resembles a point type from the Manker site in Illinois (White 1968:Fig.60-6). Probable chronology is Late Middle Woodland A.D. 300-550 (Ibid:14). (Fig. 10B).

Hematite celt fragment. (Fig. 10C).

Full grooved, hematite axe fragment. (Fig. 10D).

Non-diagnostic chert and hematite material recovered, has been summarized in Table 3. A detailed breakdown of non-diagnostic lithic material utilizing color categories established is presented in Table 4.

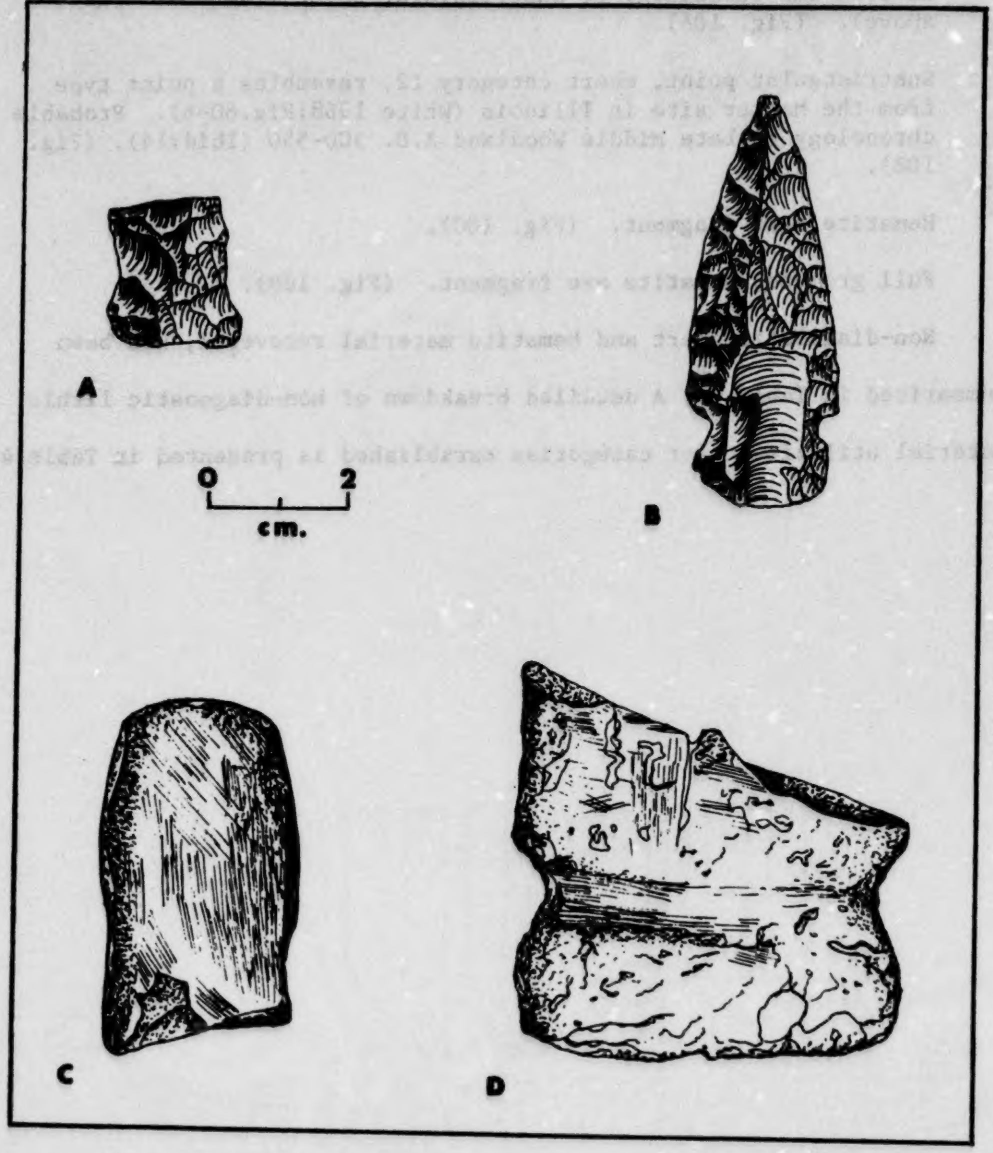


Figure 10. Chipped and ground stone artifacts from 13WP85.

Table 3: Frequency Distribution of Lithic Material.

	13WP13	13WP14	13WP85
CHERT			
Chipped Artifacts			
Bifaces and biface fragments	7	12	11
Retouched flakes	9	13	4
Retouched cores and core fragments		3	
Utilized flakes	8	10	6
Utilized core and core fragments	5	1	2
Preforms		1	
Debitage			
Waste flakes	350	209	299
Cores	2	11	14
Core fragments	137	67	48
HEMATITE			
Chipped Artifacts			
Bifaces and biface fragments	4	8	3
Preforms	2		
Ground and Polished Artifacts			
Celts and celt fragments	1	4	5
Grooved axe fragment			1
Processing Artifacts			
Hammerstones		6	
Debitage			
Cores		5	
Core fragments		7	
Waste flakes		28	22
Unworked Material			
Nodules and fragments	5	43	5
MISCELLANEOUS			
Processing Artifacts			
Hammerstones			
quartzite			2
Anvil stones			
diorite			2
Metate			
diorite			1
Unworked Material			
Fragments			
quartzite	1		1
granite	4 (10)*		2
siltstone	(1)		(2)
diorite	1		
basalt	1 (1)		
limestone	1		
gneiss	1 (3)		
sandy siltstone	10 (4)		

*Numbers in parentheses indicate burned specimens.

Table 4: Lithic Frequency Distribution Within Color Categories

Chert Category Number	Bifaces and Biface Fragments			Retouched Flakes			Utilized Flakes			Utilized Cores and Core Fragments			Waste Flakes		
	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85
1													18	7	5
2	1												21	4	8
3				1			1		1				24	3	24
4	1			1	1			1			1	2	61	15	64
5	1	1	2				1			3			14	4	18
6	1	6	1							1			11	8	13
7					1		2						12	6	4
8													2	1	2
9													1		
10		1	2	1	2	2	2	3	3				81	59	64
11	1			1				1					26	7	4
12			1	2	2			3		1			12	23	27
13								1					6	9	5
14	1		1	3					1				18	35	22
15		1	2			1							8	6	15
16		1	1	1	3		1	1					4	4	5
17		3											3	3	13
18													7		
19													10	2	
20							1						5		
21			2		1	1			1				1	6	2
22	1												2	3	
23													1		1
24													1	4	
25				1									1		3

Table 4: Lithic Frequency Distribution Within Color Categories (cont'd)

Chert Category Number	Cores			Core Fragments			Retouched Cores & Core Frags.			Preforms			Unworked Fragments		
	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85	13WP13	13WP14	13WP85
1															
2				4	1	1									
3				7	1	1									
4		1		3	2			2							
5		5	4	21	11	3									
6				8	1	5									
7				11	5	2									
8				1	7										
9				1											
10				2											
11				29	3	11									
12				7	2										
13		1		14	5										
14				5	3	6									
15		1		1	6	7					1				
16		2		5	1	1									
17	1			1	3										
18			3	2	6	3		1							
19				1											
20				1	1	1									
21	1		7	4	3										
22		1		8	5	4									
23				1											
24					1										
25						3									

Source: Author's analysis

Due to the lack of a comparative collection of cherts with geologic provenience, the sources of these cherts must be speculative.

Descriptions in the geologic literature are not adequate to assign cherts from the prehistoric sites directly to their sources, be they bedrock, glacial drift or alluvium. However, the cherts from measured stratigraphic sections in the geologic literature can be systematically collected and a comparative collection thus be built. To increase the value of such a comparative collection, duplicate chert specimens can be heat-treated to reproduce changes in color and/or structure analogous to those induced prehistorically.

This proposed stratigraphic comparative collection, would provide a basis for the archaeological description, e.g., structure, fracturing characteristics, surface textures, color, cortex type, fossil content, etc. of geologic units and would necessarily lead to more systematic descriptions of chert which would elucidate cultural patterns, e.g., trade networks and resource utilization.

CERAMICS

One minute piece of amorphous grit-tempered pottery was recovered from 13WP13. This pottery could be tentatively assigned to the Middle Woodland period, ca. 250 B.C.-500 A.D. (White 1968:Fig.3).

Discussion

The three prehistoric sites offer evidence for various activities which have taken place during certain periods in the past. A number of functions are suggested by the artifactual remains and features encountered (Table 5).

Table 5: Interpretation of Evidence from Prehistoric Sites

Evidence	Interpretation(s)
Discontinuous post molds	Temporary shelters, e.g., lean-to
Fire hearths, burned rock, and charcoal areas	Food processing, warmth
Projectile points (also used as knives) bifaces	Procurement of game, processing of game.
Scrapers, utilized flakes and cores	Skinning hide preparation blade manufacture
Metate (grinding slab)	Vegetable processing
Hammerstones and debitage	Chert processing

Since the cultural chronology suggested is Woodland, house structures and storage pits would certainly be present if the sites were permanent villages. The sites probably represent temporary occupations established for the extraction and processing (exploitation) of natural resources. The main occupation sites (permanent or semi-permanent villages) are probably located elsewhere, undoubtedly nearby. Recent surveys in the area conducted by Anton Till, Division of Historic Preservation may supply the data necessary to interpret this settlement pattern more completely. The lack of pottery is further suggestive of temporary occupations at the sites. The artifact assemblages must be studied in light of other nearby Woodland sites to more fully interpret both settlement and exploitative patterns in this part of the Des Moines River Valley.

THE HISTORIC SITES 13WP22 AND 13WP25

Historical Background

Owing to the geographically restricted nature of this report, a detailed historical overview of Wapello County will not be presented here. The reader is referred to Biggs 1865 and Boyd 1867 for sketches of the early settlement; and the county histories of Western Historical Company 1878, Evans 1901, and Waterman 1914 for a more general presentation. Waterman 1914 contains the most comprehensive and detailed historical account of Wapello County. A brief summary of the history of settlement as pertains to the project area is given below as a means of introduction.

When the title to land belonging to the Sac and Fox Indians passed by cession into possession of the United States Government on May 1, 1843, the settlement commenced of what would become Wapello County (Andreas, 1875:364) Immediately population centers grew at Ottumwa, Agency City, Eddyville and Dahlonega.

The town of Chillicothe was platted in 1849 by A. J. Wicker who had originally located near the mouth of Avery Creek in February, 1845 (Western Historical Company, 1878:537). In the period between 1845 and 1849, settlers had been moving into the area surrounding Chillicothe. Indeed, the lands on which 13WP22 and 13WP25 are located were both entered from the U. S. Government in 1848. The original government land plat is shown in Fig. 11. Following is a history of the land tenure of site 13WP22. Specific information regarding land owners is given as may be useful for reviewing the archaeological record.

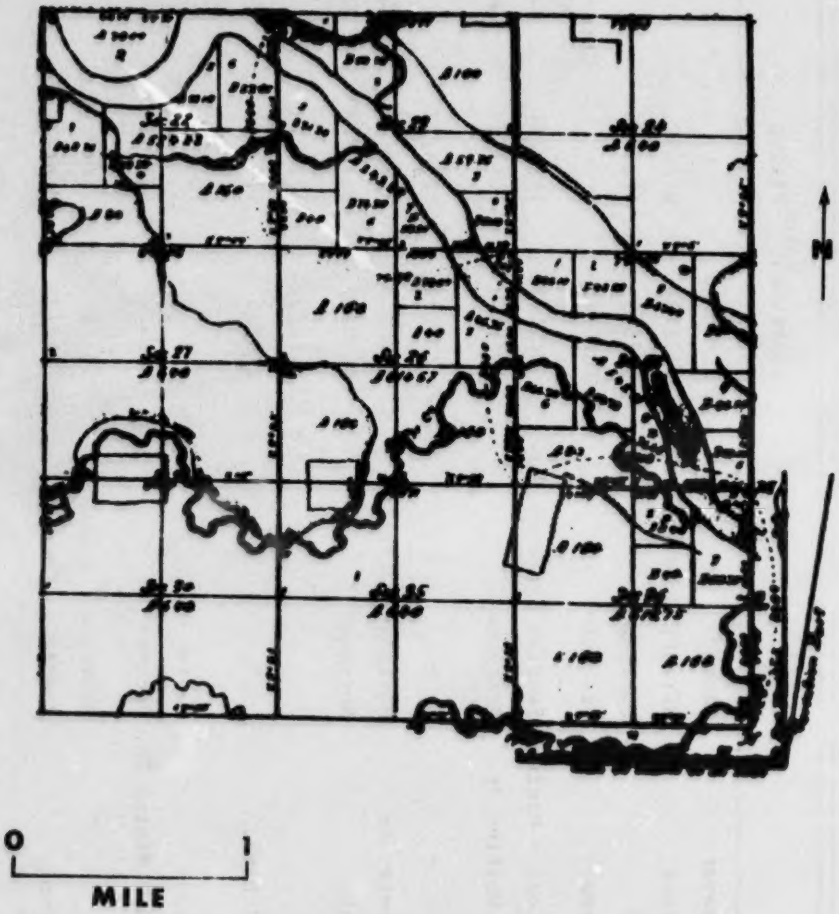


Figure 11. Government Land Office Plat of the southeast portion of Township 73 North, Range 15 West. U. S. Government Land Survey Office, 1847 ms.

Table 6 : Transfer of Land Record for the N W ¼ of Section 26, T73N, R15W

Grantor	Grantee	Instrument	Dates		Comment
			Instrument	Filing	
U. S. Government	N. Dofflemeyer	Entry	12/16/48		
N. Dofflemeyer	J. G. Haycock	Waranty Deed	1/31/52	2/2/52	
J. G. Haycock	same elder	Mortgage	5/21/55	5/21/55	
J. G. Heacock (by treasurer)	A. G. Harrow	Tax Sale	10/5/71		Structure located on Warner (1870) plat map of Wapello County.
W. M. King	National Coal & Mining Co.	Special Warranty Deed	10/25/71	11/4/71	Coal rights-Western 60 acres
National Coal & Mining Co.	Joseph H. Whiting Jr.	Mortgage	10/7/72	10/7/72	Western 60 acres
"	" "	"	2/14/73	2/25/73	" " "
J. G. Heacock	Wm. Jackaberry Co	Mortgage satisfied	2/25/73	2/26/73	East 91 rds. of South 40 rds.
J. G. Heacock & J. M. Hull	J. M. Shelby	Mortgage	6/10/73	6/10/73	Except 40 acres
"	"	"	6/18/73	6/18/73	"
National Coal & Mining Co.	Iowa Nat'l Bank, Ottumwa	"	1/9/74	1/21/74	Coal rights as above
James Shelby	J. G. Heacock	Decree	4/74	4/74	Except S E ¼ of N W ¼
Iowa Nat'l Bank Ottumwa	Nat'l Coal & Mining Co.	Decree	4/74	4/74	Coal rights as above
John Whitney	" " "	Decree	11/74	11/74	" " " "
T. A. Spillman (sheriff)	J. H. Whiting (trustee)	Sheriff's Deed	1/30/75	2/6/75	" " " "
J. G. & S. P. Heacock	Benjamin Haynes	Mortgage	7/22/75	7/22/75	South 40 rds. of East 91 rds. of S ½ of N.W.¼
J. G. Heacock	H. B. Heacock	Mortgage	3/18/76	6/1/76	W½ NW¼ & NE¼ NW¼
Charles Blake	J. G. Heacock	Foreclosure	8/76	8/76	" " " "

Table 6 : Transfer of Land Record for the N W ¼ of Section 26, T73N, R15W (continued)

Grantor	Grantee	Instrument	Dates		Comment
			Instrument	Filing	
T. A. Spillman (Sheriff)	Henry B. Heacock	Sheriff's Deed	10/30/77	10.30/77	W½ NW¼ & NE¼ NW¼
Treasurer	Henry B. Heacock	Treasurer's Deed	4/16/78	4/16/78	N½ NW¼
H. B. Heacock	John A. Brown	Mortgage	3/4/78	4/15/78	W½ NW¼ & NE¼ NW¼
George G. Heacock	H. B. Heacock	Mortgage	3/1/79	3/4/79	Portion of NW¼
H. B. Heacock	The Public	Auction	3/24/79	10/30/79	Fraudulently paid mortgage
H. B. Heacock	Lawrence Guggerty	Warranty Deed	4/7/85	4/18/85	
In matter of Estate of Lawrence Guggerty			12/18/15	12/18/15	Structure does not appear on Allen (1893) plat map of Wapello County.

Source: Allen 1893, McElroy, Truitt and Truitt, n.d.a: 385-386, Warner 1870 and author's research.

13WP22

Transfer of land records are listed in Table 6 . The most prominent figure involved in the land transactions is John G. Heacock. He came to Iowa in 1852 from Ohio, secured the title to the NW¼ of Section 26 (T73N, R15W) and commenced farming operations. By 1856 Heacock was engaged in milling operations. The citation for Heacock in the 1856 Census (Iowa Census Board 1856 ms; Wapello County: 731-732) gives a picture of his individual estate:

> 116 acres (a) owned, produced 1 ton hay; spring wheat 5a - 5 bu.; winter wheat 5a - 15 bu.; oats 5a - 300 bu.; corn 40 a - 2600 bu.; potatoes 1a -60 bu.; sold 15 hogs - $120; sold 5 cattle - $55; made 100 lb. butter; made 27 lb. wool.

Further notice is made concerning Heacock's profession as a farmer and miller. Waterman (1914, vol. 1:353) notes that by 1865 Chillicothe had a grist mill owned and operated by J. G. and S. P. Heacock which was capable of turning out 300 bushels a day.

The capital which Heacock enjoyed as a result of his farming and milling enterprises was considerable. The figures are shown below:

Table 7: The Capital of J. G. Heacock

Date	Valuation		Source
	Land	Personal Property	
1857	4128	796	Wapello Co. Assessor 1857 ms
1860	4080	1120	U. S. Bureau of the Census 1860
1870	20000	2149	U. S. Bureau of the Census 1870

The census records also indicate that in 1860, Heacock had a wife and five children (Census Bureau 1860:602).

The title transfer record for the Southwest quarter of Section 26, T73N, R15W is presented in Table 8.

The person who appears to be significant with regard to 13WP25 is D. S. McQuiston. All that is known from available archival sources about Davis S. McQuiston is the description in the 1870 Federal Census (U. S. Census Bureau 1870:39) which lists him as: 35 years of age, born in Pennsylvania, married to a woman born in Iowa, father of three children born in Iowa. One woman (possibly mother-in-law) is also listed as being in the household. The real estate owned by McQuiston is valued at $6000 and his personal estate at $819.

McQuiston appears to have been involved in some irregular deed transaction with the former title holder of the land, Joshua Lowmiller (see Table 8). The entire transaction scheme is not entirely clear, but McQuiston lost the title to the land after being the holder for two years. According to Loren Horton (personal communication), the fact that McQuiston took out a mortgage on the land in 1869 is a positive sign that he was planning to build a house on it. The fact that a structure is shown by Warner (1870) (Fig. 12) on the land of D. S. McQuiston is further evidence that the house is McQuiston's and that it was probably built after March 1, 1869.

Table 8 : Transfer of Land Record for the S W ¼ of Section 26, T73N, R15W

Grantor	Grantee	Instrument	Dates		Comment
			Instrument	Filing	
U. S. Government	Hiram Webb	Entry	12/20/48		
Hiram Webb	Sam Webb	Warranty Deed	3/24/51	3/5/54	
Sam Webb	Joshua Lowmiller	Warranty Deed	11/1/55	11/3/55	
Joshua Lowmiller	D. S. McQuinston	Warranty Deed	2/11/69	4/30/69	
D. S. McQuinston	J. Lowmiller	Mortgage	3/1/69	4/30/69	
J. Lowmiller	D. S. McQuimston	Returned execution (Court Sale)	5/14/71	8/15/71	
J. Lowmiller	D. S. McQuimston	Decree		6/16/71	Structure present on Warner (1870) plat map of Wapello County
Sheriff	J. Lowmiller	Sheriff's Deed	8/15/71	8/15/71	
J. Lowmiller	P. Omalia	Warranty Deed	1/17/77	2/2/77	
P. Omalia	Joseph Jewitt	Mortgage	11/13/84	11/18/84	
P. Omalia	Bridget Molony	Mortgage	9/29/86	10/14/87	
P. Omalley	J. H. Waddington	Mortgage	2/7/87	2/7/87	Structure not present on Allen (1893) plat map of Wapello County.
J. Jewitt	P. Omalley	Extension	10/13/96	3/16/97	
P. Omalley	J. J. Omalley	will			

Source: Allen 1893; McElroy, Truitt and Truitt n.d.a: 385-386; Warner 1870; and author's analysis.

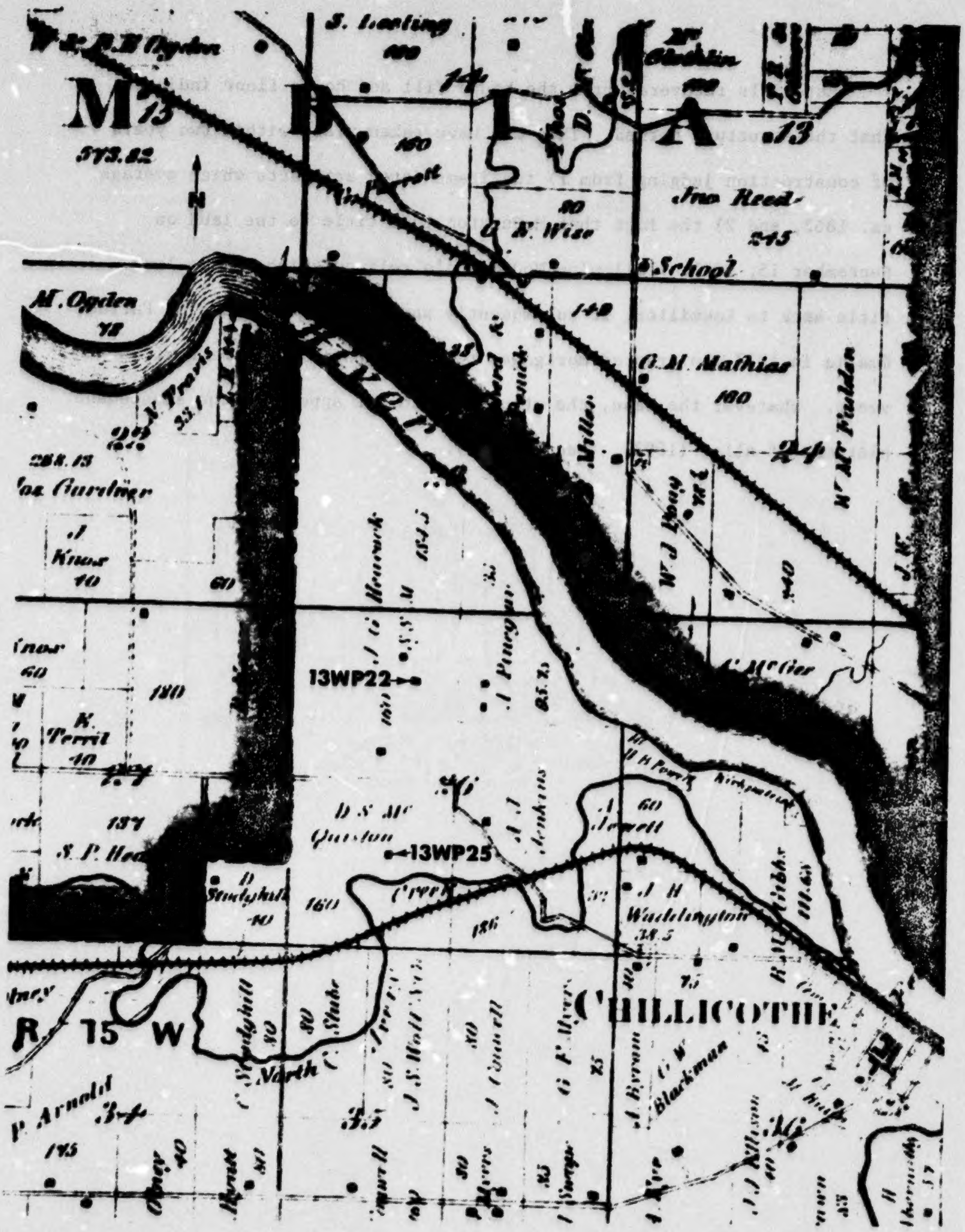


Figure 12. Southeast portion of Township 73 North, Range 15 West in 1870 showing sites 13WP22 and 13WP25. Warner (1870).

Materials recovered from the house fill and house floor indicate that the structure burned. This may have taken place within two years of construction judging from 1) the items dated artifacts which average ca. 1862, and 2) the fact that McQuiston lost title to the land on September 15, 1871. Following McQuiston's relinquishing of the land title back to Lowmiller, it subsequently passed into the hands of Patrick Omalia in 1877 who granted mortgages to four persons over the next 20 years. Whatever the case, the structure did not appear on the subsequent plat map of Allen (1893) (See Fig. 13).

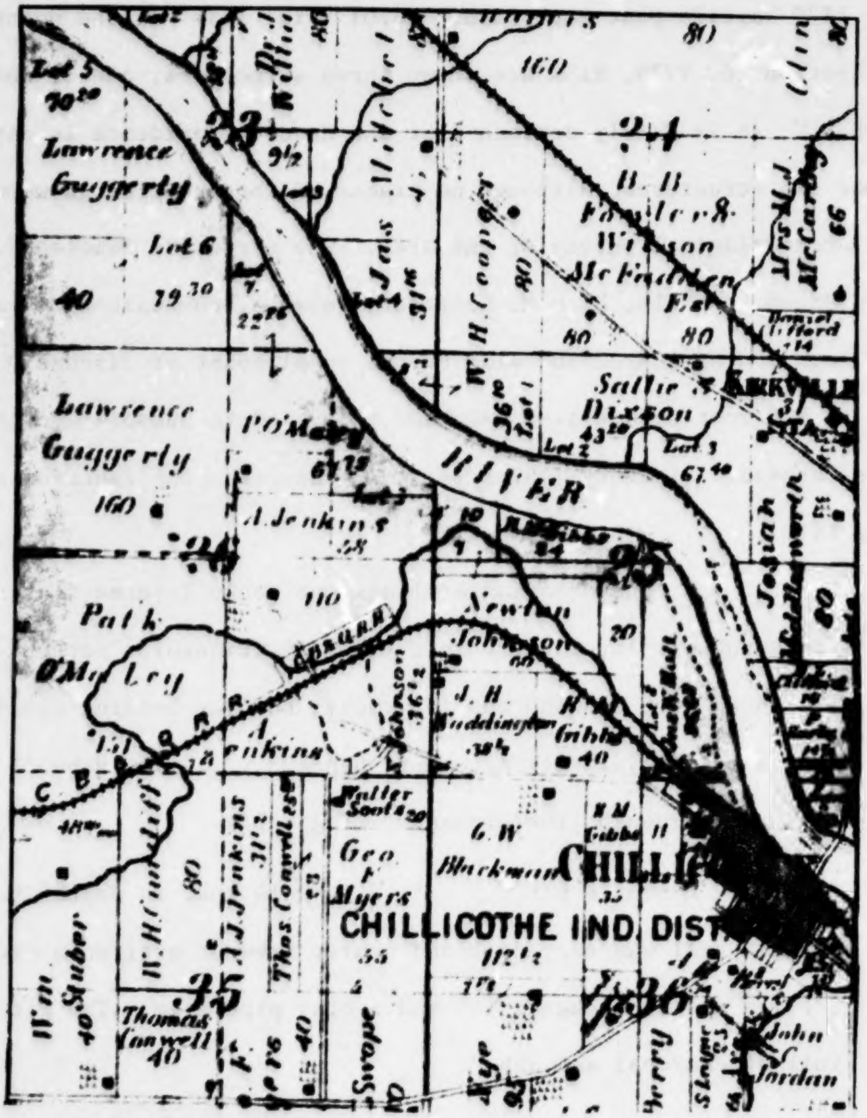


Figure 13. Southeast Portion of Township 73 North, Range 15 West in 1893. Allen (1893).

Site Plans

13WP22

The first evidence of occupation on the Heacock property is found on the 1870 Wapello plat map (Warner 1870) (Fig. 12). In the northwest quarter of Section 26, T73N, R15W are shown three structures, one of which is labeled "S.S.M." It is fairly certain that the Heacock residence is one of the other two structures, although no traces of these buildings were found on the archaeological survey of the area. The structure labeled S.S.M (probably Steam Saw Mill, Alan M. Schroder, personal communication) appears in the location of 13WP22 and will be the focal point of discussion following:

A 900 foot square area was hand excavated to subsoil and three features were located. Slattery (1976a ms:11-12) describe the features as follows Fig. 14):

> 1)" . . . A concentration of limestone rocks layered flat some 10 in. above subsoil level . . . in a slightly triangular pattern . . . A few rocks were beneath the cap rocks, however nothing could be seen of [a meaningful]rock structure beneath . . . The subsoil was not disturbed beneath [the] rocks." (Fig. 15A).
>
> 2)" . . . A simple pit . . . 51 x 41 x 10 ins. in depth (below subsoil). The pit fill was very dark and nearly free of artifacts except for . . . . a rusted bucket . . . and a clay pipe stem. The pit fill was full of charcoal and ash."
>
> 3)" . . . several bricks [lying] at various angles and an ash layer together with a few stones (limestone). All of this some 10 in. above subsoil level. After excavation of these items no evidence of anything further was noted."

An area north of the Features 1 and 2 contained a heavy scattering of cultural debris. This area was partially within the area of excavation and partially without (Fig. 14)

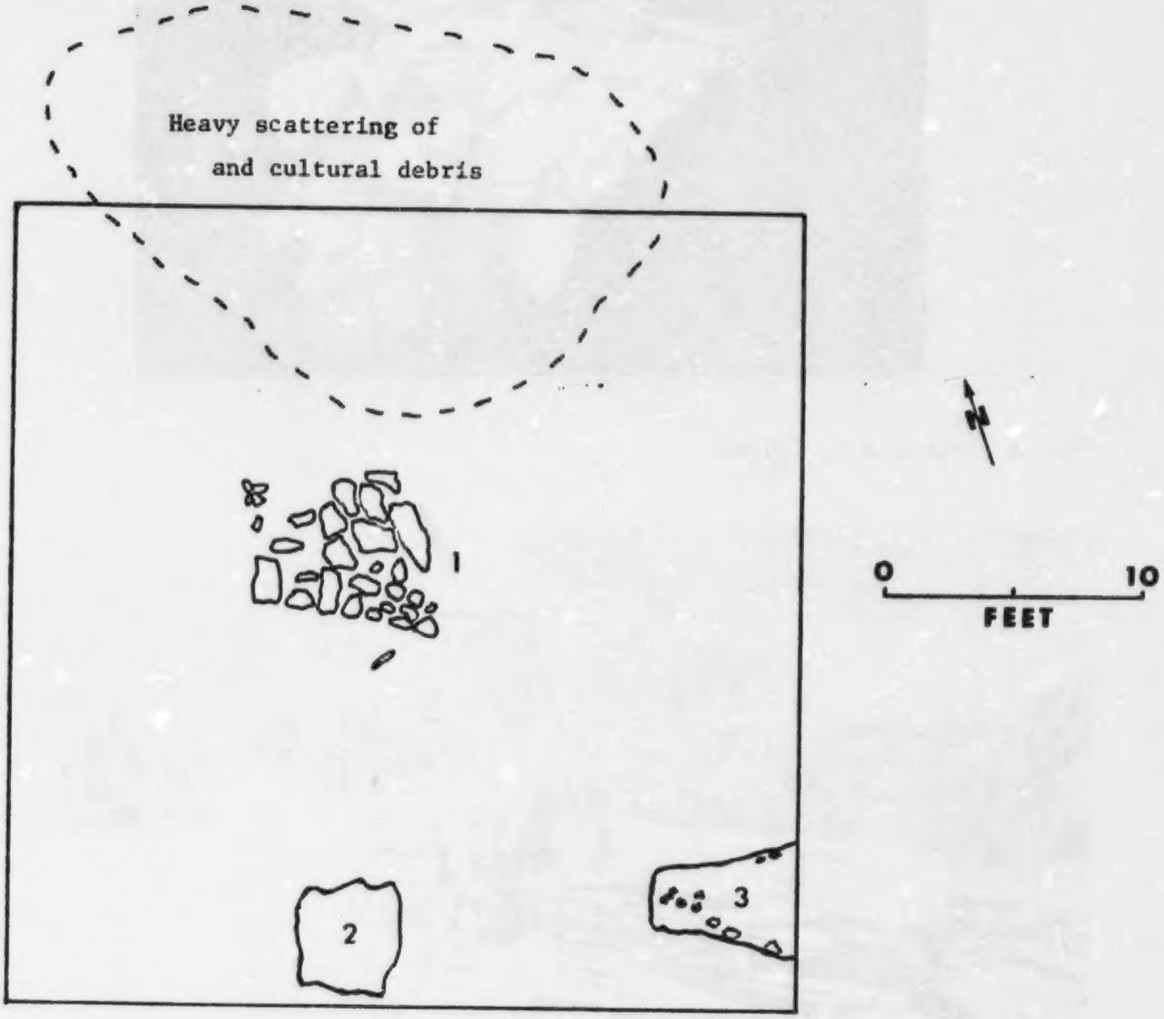
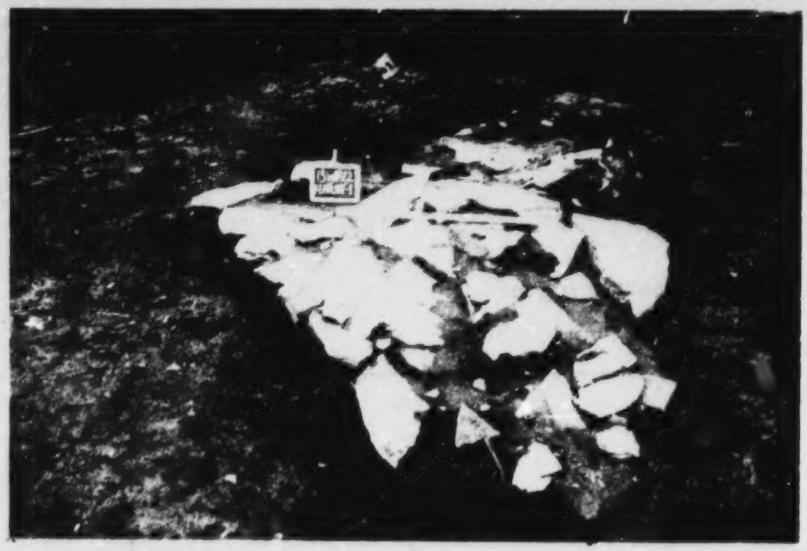
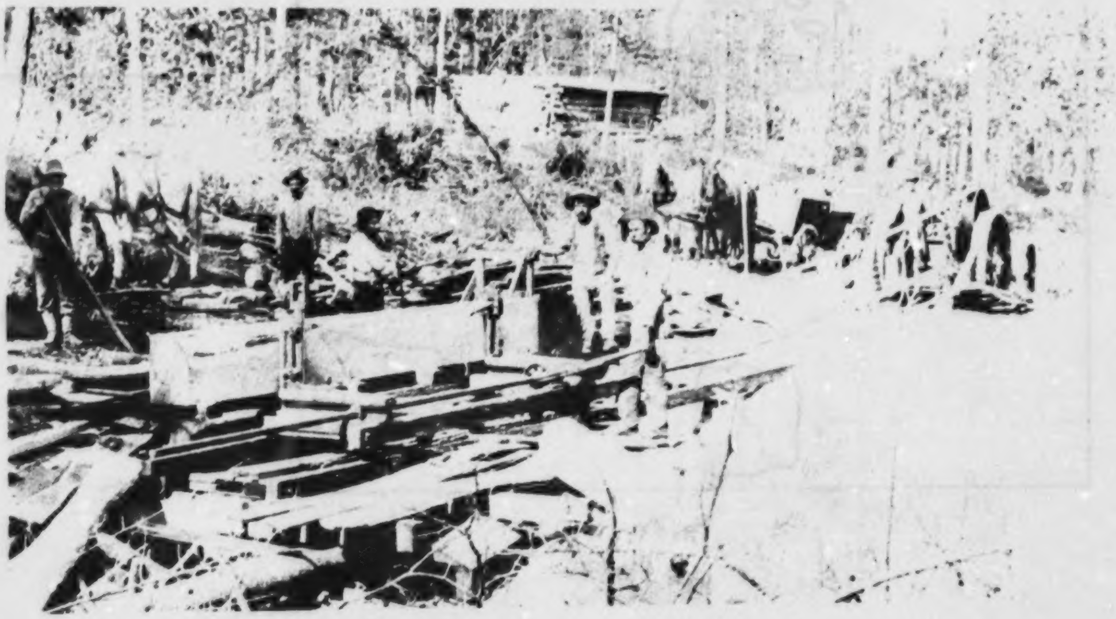


Figure 14. Site Plan, 13WP22, showing Features 1-3. After Slattery (1976c ms.).



A. Feature 1, 13WP22.



B. Portable steam saw mill near Iowa City, ca. 1893. Courtesy of Iowa State Historical Department, Division of the State Historical Society, photograph collection.

Figure 15. 13WP22, Feature 1 and a portable steam saw mill near Iowa City, Iowa.

Schroder (personal communication) of the State Historical Society suggested the "S.S.M." might refer to a steam-saw mill of a portable type used in the late Nineteenth century. A saw mill of this type is reproduced in Fig. 15B. In this context, Schroder suggested that feature 1 could represent a platform for the boiler, motor or rigging, Feature 2 could either be a pit for reducing wood to charcoal for more economy in buring in the boiler or for disposing of wood shavings, and the scattering of artifacts north of the Features 1 and 2 may be the remains of a small shack or building adjoining the mill. The shack possibility shall remain speculative as the front end loader accidentally dug too deeply in that area and removed a swath of soil adjacent to the excavated area (Slattery, personal communication). Such a shack was frequently associated with saw mills of this type and is shown in the background of Fig. 15.

13WP25

Removal of the plowzone from historic site 13WP25 revealed three features related to an historic farmstead: the cellar of a house, a well and a refuse pit (Fig. 16).

THE HOUSE

Slattery (1976a ms) described the house as completely collapsed with a few limestone rocks strewn unpatterned throughout the site. The fill within the house was a heavy mixture of limestone rock, broken brick, and artifacturl material (described subsequently in this report). The subsurface floor of the house basement was located four feet below present ground surface and followed until the side walls were located and defined as being 12 x 14 ft. in dimensions. A stone apron and entryway 3 ft. wide was also delineated. There was no indication that the limits of the basement excavation represented the entire dimensions of the superstructure.

Within the house fill were found charred wooden beams, as well as burned china and melted glass, indicating that a fire destroyed the wooden

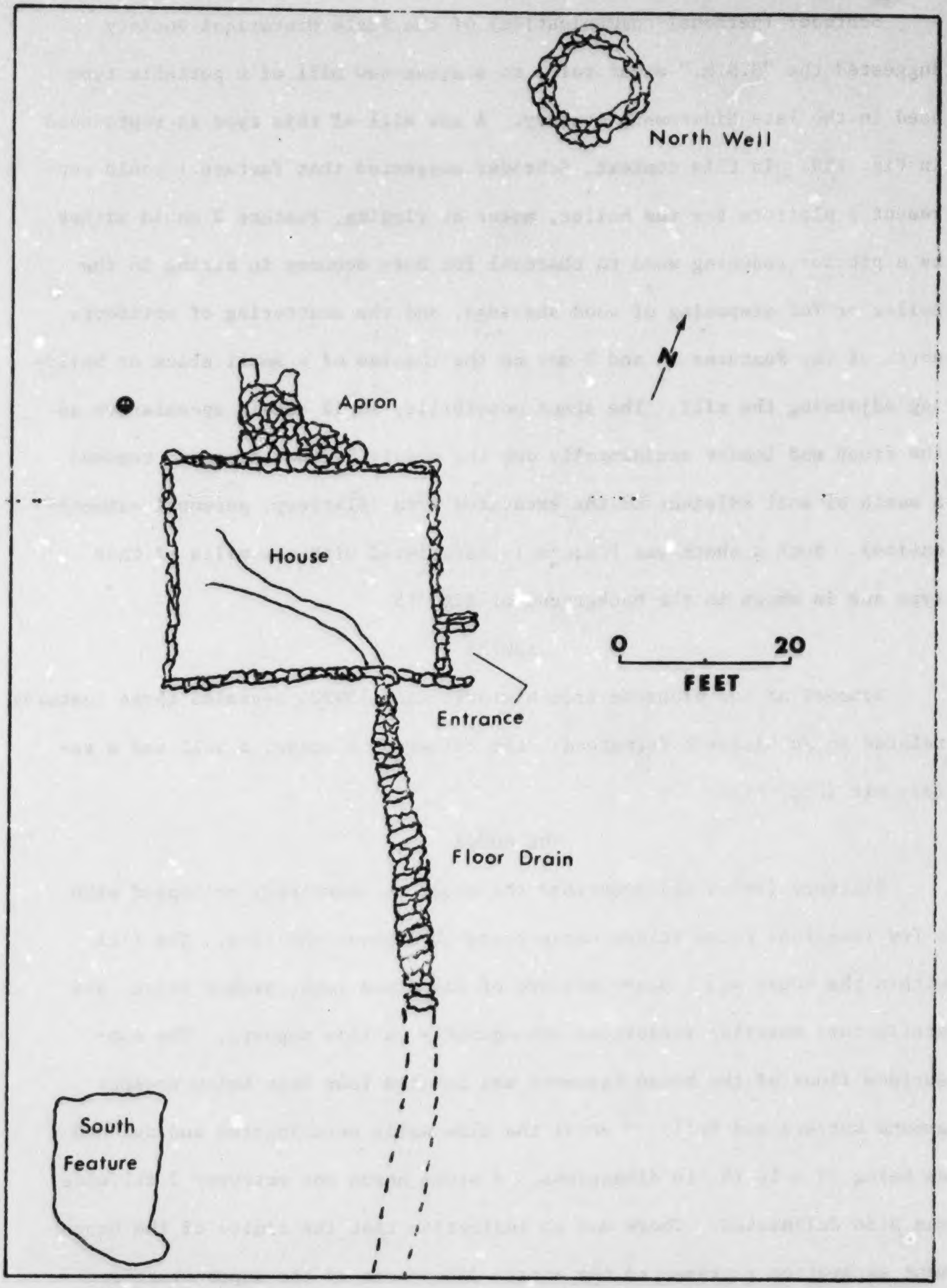


Figure 16. Site Plan, 13WP25. After Slattery (1976c ms.).

structure above ground. No patterning in the fallen beams could be ascertained. The house and the well were linked temporally by the discovery of one piece of china from each of the features which, when joined, comprised a single sherd.

The limestone used in construction is certainly from the local St. Louis formation which Leonard (1902) recognized as a geologically suitable building stone exposed and quarried at several places near Chillicothe. The limestone had been cut, dressed and laid in a Regular Ashlar Bond construction (Horton 1972 ms: 4 and personal communication) (Fig. 17a).

THE NORTH WELL

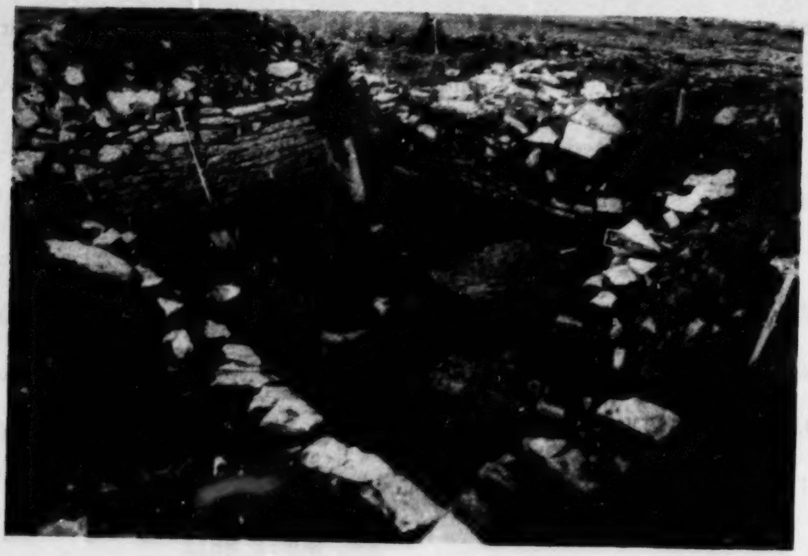
This feature located about 25 ft. north of the house contained a fill of broken limestone and brick fragments (Fig. 16). At a depth of 5 ft. below present ground surface a limestone circular wall of 5 ft. 2 in. inside diameter which extended down 9 ft. further. Within this feature was recovered a complete horse skeleton and a few artifacts, mainly nails. There was evidence that wooden framing or shoring once existed above the limestone circular wall.

THE SOUTH FEATURE

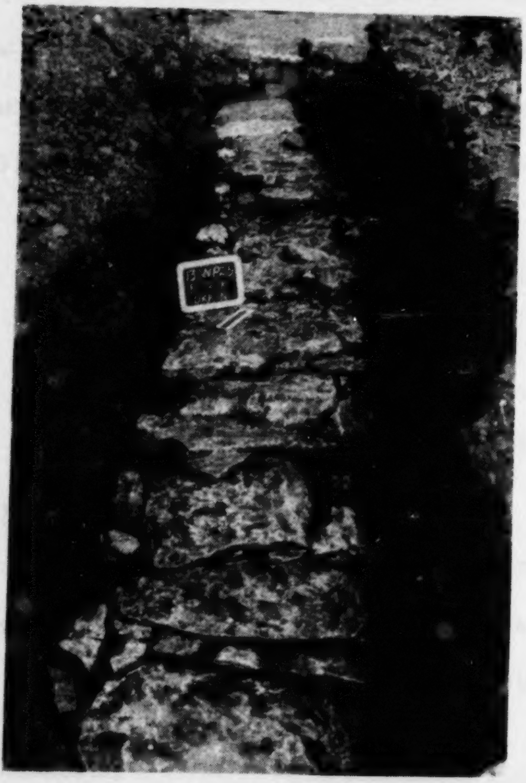
A refuse pit was located about 30 ft. south of the house. Much artifactual material was recovered from this feature. The irregular shape of this feature is displayed in Fig. 16. Slattery (1976a ms:8) describes a stratigraphic profile of this feature as: cultural within the top 18 ins., a steril layer, and a darker soil layer beneath which a "floor" of charcoal and ash was present.

THE FLOOR DRAIN

Slattery (1976a ms:4) noted a trench on the subsurface floor of the house "8 ins. wide and 3 ins. deep angling across the floor [and] ending near the SE corner of the basement." Subsequent excavation showed this



A. General view of house during excavation.



B. View of the base of the floor drain.

Figure 17. Views of the house and floor drain at 13WP25.

trench extending through the basement wall and into "a long...underground, rock covered, rock sided trench... which extended 37 ft. to a lower exit elevation (Slattery 1976a ms:6). Stone construction of this trench is shown in Fig. 17B. The floor drain was built with a great deal of care. Loren Horton (personal communication) relates that very rarely in 19th century Iowa did houses have a stone floor drain. He knew of only one other house (the Antoine LeClaire House in Davenport) with such a feature. This may be a custom originally from the British Isles, i.e., an anachronism, as such construction appears to be Medieval in style.

Guilland (1971:9) posits a reason for construction of this floor drain: "Some New Jersey and Pennsylvania settlers dug basements which were used for kitchens in the warmer months. These basement kitchens often had running water from springs under the house..." It is noteworthy that McQuiston, the builder of the house, is from Pennsylvania.

Also Guilland (1971:7) points out that basements of houses were used in the warmer months for storage of perishable items such as butter, milk and meat. This might account for the stoneware recovered from the basement floor (see below). If there was a spring in the basement, cooling of the perishable items would have been facilitated.

Material Culture Inventory

The artifactual material recovered from both the Phase II and Phase III work is included in the descriptions below. For additional illustrations of china from the sites see Slattery and Tandarich (1975:43). Much of the metal recovered was not identifiable. This compliation represents an attempt to provide future researchers with a listing of items associated with these particular site types, the first known to have been excavated in Iowa.

CLAY BODY MATERIALS

STONEWARE

Reynolds (1969 ms) and Schulte (1974 ms) have made the first attempts to analyze stoneware from local kilns in Iowa. Their categorizations of vessel forms are useful for describing the stoneware from both 13WP22 and 13WP25. Reynolds designed rim forms categories for analytic use. The distinctions he made between his "folded" and "reserve" rim are not clear to this writer from his profile drawings alone. Therefore, a rim analysis is not presented in this report.

The basic vessel forms and probable number of different vessels represented at 13WP22 and 13WP25 are presented below.

Table 9: Stoneware Form Summary

	Number				
Form Type	Definite		Questionable		Form Type Illustration
	13WP22	13WP25	13WP22	13WP25	
Simple Bowl	2	8	2	1	Fig. 18D, 18J
Milk Bowl	9	5	1	0	Fig. 18E
Crock (all types)	7	4	1	0	Fig. 18F 18J
Jar (all types)	3	2	1	0	Fig. 18B, 18C
Jug	0	3	0	1	Fig. 18A
Cover	0	1	0	0	Fig. 18J
Holder	0	2	0	0	Fig. 18K

Source: Reynolds 1969 ms; Schulte 1974 ms, and author's analysis.

More detailed descriptions of the stoneware from both sites are presented in Tables 10 and 11. The stoneware sample being small and fragmentary made

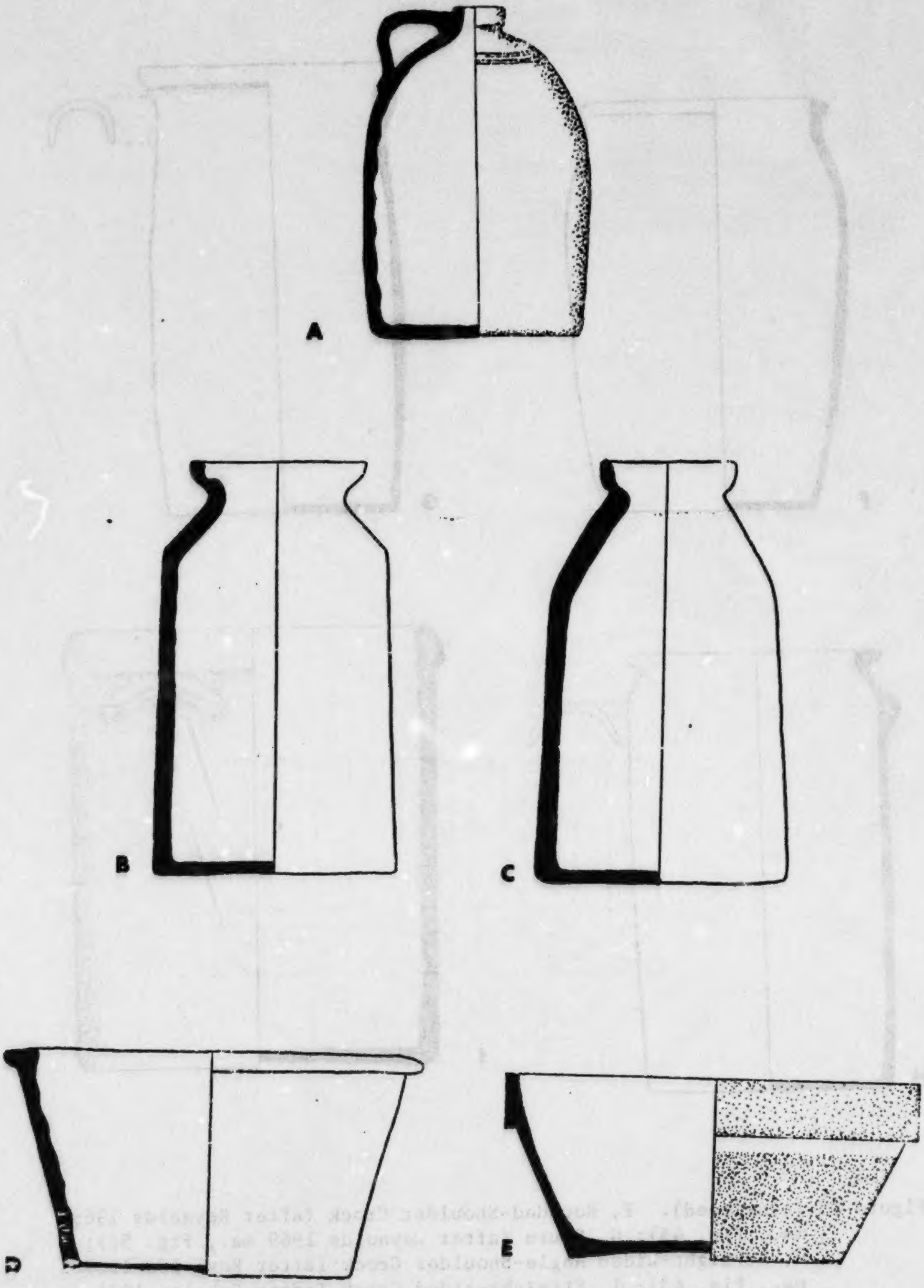


Figure 18. Stoneware vessel forms at 13WP22 and 13WP25. Not to scale. A. Jug (after Schulte 1974 ms., Fig. 31); B, Angle Shoulder Jar (after Reynolds 1969 ms., Fig. 48); C, Rounded Shoulder Jar (after Reynolds 1969 ms., Fig. 49); D, Simple Bowl (after Reynolds 1969 ms., Fig. 39); E, Milk Bowl (after Schulte 1974 ms., Fig. 12A).

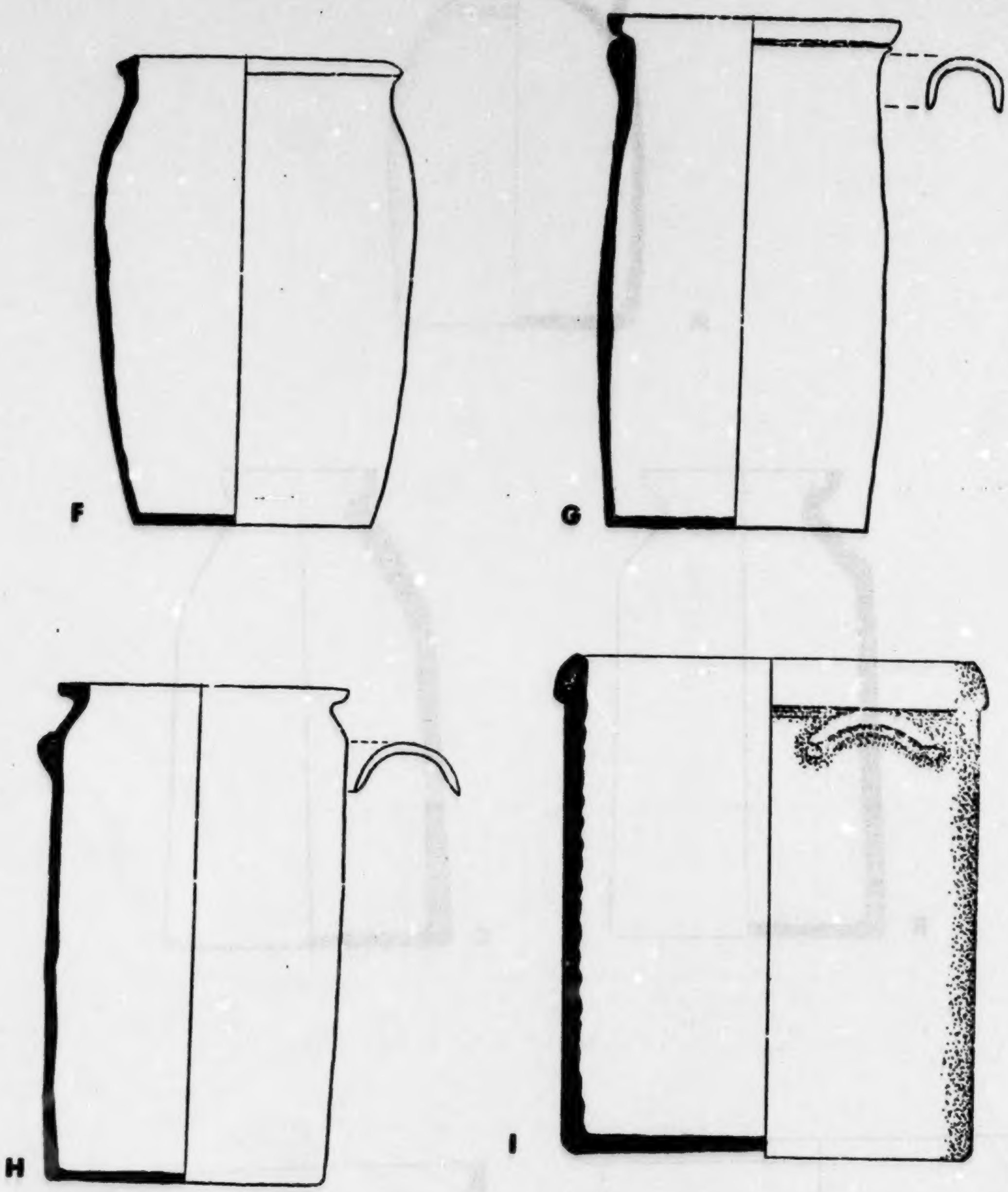


Figure 18 (continued). F, Rounded-Shoulder Crock (after Reynolds 1969 ms., Fig. 45); G, Churn (after Reynolds 1969 ms., Fig. 52); H, Straight-sided Angle-Shoulder Crock (after Reynolds 1969 ms., Fig. 43); I, Straight-sided Crock (after Schulte 1974 ms., Fig. 14).

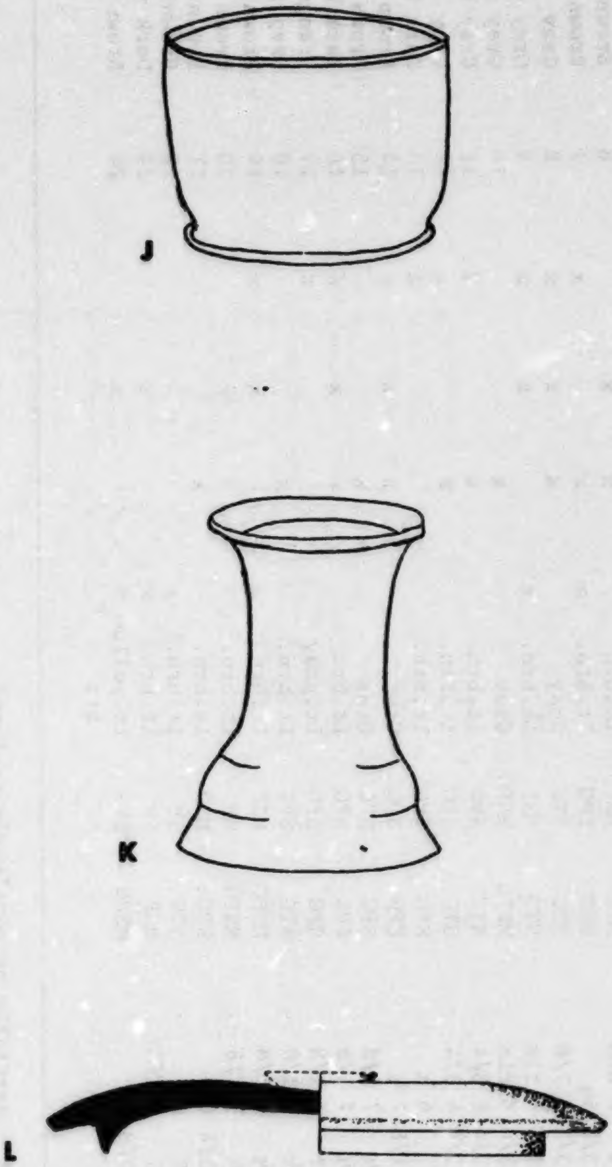


Figure 18 (continued). J, Bowl or Cup (after Rice and Stoudt 1929, No. 44); K, Holder (after Rice and Stoudt 1929, No. 141); L, Cover for Crock and/or Churn (after Schulte 1974 ms., Fig. 29D).

Table 10: Analysis of Stoneware From 13WP22

umber of 'ragments [a]	Form	Vessel Dimensions (in inches) Rim	Base	Total Height [b]	Surface Treatment [c] Extnl.	Intnl.	Paste Color[d]	Finger Ridges	Striations Intnl.	Extnl.	Rim Tooling	Reference Number	External Color [e]
9	Crock[f]	3/4	8 3/4		STG	MSPG	Lt.brn.	x		x	x	1	Lt. yellow brn mottled
12	Milk Bowl	10¼	< rim		MSPG	MSPG	Lt.brn.		x	x		2	Brown
7	Crock	11	7 7/8		STG	MSPG	Gray	x		x	x	3	Green & brown mottled
5	Jar ?	?	3 1/8		STG	STG	Lt.gray		x			4	Cream
4	Crock	6¼	5 ½		STG	STG	Lt.brn.	x				5	Green
7	Milk Bowl	10¼	8 3/4		MSP	MSP	Lt.brn		x	x		6	Brown
11	Jar	4 3/8	5½		STG	SPG	Lt.brn.	x	x		x	7	Brown
8	Crock?	8 3/4	7 7/8		STG	STG	Gray		x	x	x	8	Gray
11	Jar	?	> rim		STG	MSP	Lt.brn.	x		x	x	9	Gray green [g]
5	Bowl?	8 3/4	< rim		MSPG	MSPG	Gray		x			10	Gray green
7	Crock	8 3/4	8 3/4		STG	SPG	Lt.brn.		x		x	11	Gray brown mottled
7	Bowl?	8 3/4	6 3/4		STG	SPG	Lt.brn.		x		x	12	Gray
7	Crock or jar	?	6 ¼		SPG	SPG	Lt.brn.				x	13	Dark brown
9	Jar	7 1/8	7 ½		SPG	SPG	Gray		x	x	x	14	Brown
12	Milk Bowl	10¼	7 1/8		SPG	SPG	Gray		x			15	Brown
9	Milk Bowl	10¼	7 1/8		SPG	SPG	Lt.brn.		x	x	x	16	Dark brown
5	Milk Bowl	?	7 1/8		SPG	SPG	Lt.gray				x	17	Orange brown
4	Milk Bowl	10¼	7 1/8		STG	SPG	Lt.brn.		x			18	Gray green
3	Milk Bowl	10¼	7 1/8		MSPG	MSP	Lt.brn.	x		x	x	19	Brown
4	Milk Bowl	10¼	7 1/8		MSPG	SP	Lt.brn.		x	x		20	Brown (below rim)
7	Bowl	8 3/4	6¼		STG	MSP	Lt.brn.		x			21	Brownish green
4	Crock	?	6¼		STG	SP	Lt.brn.	x				22	Brownish green
3	Milk Bown	?	7 1/8		MSP	SP	Lt.brn.	x		x		23	Dark yellow brown
3	Crock	7 7/8	?		MSPG	SPG	Lt.yellow brn	x		x		24	Brown

a Abbreviation: R - partially or completely restored

b Vessel height was indeterminable in all cases for material from 13WP22

c Abbreviations: STG-salt glaze; SPG-slip glaze; MSPG-matte slip glaze; MSP-matte slip unglazed

d Color names based on Munsell Soil Color Chart, Hue 10 YR

e Not standard colors; some colors vary over surface of vessel

f Impressed mark of Mayer & Br. present see text

g Evidence of a cobalt blue decoration, design not discriminable

Source: Author's analysis

Table 11 : Analysis of Stoneware from 13WP25

umber of a ragments	Form	Vessel Dimensions (in inches)		Total	Surface Treatment[b]		Paste[c]	Finger	Striations		Rim	Ref.	Prove-[d]	External[e]
		Rim	Base	Height	Extnl.	Intnl.	Color	Ridges	Intnl.	Extnl.	Tooling	No.	nience	Color
1	Bowl	9 3/4		5 3/8	SPG	MSP	Gray	x			x	1	SF	Brown
1	Crock	7 7/8	?	?	SPG	MSP	Gray			x	x	2	SF	Gray
1	Bowl	7 7/8			SPG	SPG	L.brn.	x			x	3	H	Brown
	Bowl	8 3/4			SPG	MSP	Gray		x	x	x	4	SF	Green
R	Milk Bowl	10 ¼		4½	SPG	SPG	L.brn.				x	5	H,SF	Dusky red
R	Milk Bowl	10 ¼	6 3/4	4 3/4	MSP	MSP	L.brn.			x	x	6	HF	Reddish brown
	Milk Bowl	10 1/8	6 3/4	4¼	SPG	SPG	L.brn.		x	x	x	7	HF	Yellow greenish brn.
R	Jug	1 ¼	7 1/8	10	MSP	MSP	L.brn.	x	x		x	8	HF	Lt.orange brn.
R	Jug	1	7 7/8	8½	SPG	SPG	L.brn.	x				9	HF	Deep brn.
R	Jug?	?	7	?	SPG	SPG	L.gray	x			?	10	HF	Brown
3	Crock[f]	10¼	8 3/4	?	SPG	SPG	Gray			x		11	S,H,SF	Gray green
1	Crock	10¼	?	?	SPG	SPG	L.gray	X		X		12	H	Brown yellow
1	Bowl	?	9 1/16	?	SPG	SPG	L.gray				?	13	H	Orange brown
1	Jar	2 3/4	?	?	SPG	SPG	L.brn.					14	HF	Brown
1	Jar	6¼	?	?	MPS	MPS	Gray	x				15	H	Mottled brown
6	Bowl	8 3/4	6 3/4	?	MSP	SPG	L.brn.			x	x	16	H,SF	Lt.orange
6	Bowl	10¼	7 1/16	?	SPG	MSP	L.brn.			x	x	17	H,SF	Orange brown
3	Crock	7 7/8	?	?	STG	MSP	Gray			x		18	SF	Greenish gray
1	Cover[g]	9 5/8	7 7/8	?	STG	MSP	L.brn.			x		19	SF	Greenish gray
13	Jug	1 1/16	?	?	SPG	SPG	Gray	x			x	20	HF,H	Dark greenish brn.
1	Holder[h]	?	2¼	?	None	None	Gray				?	21	H	Gray
1	Bowl	10¼	rim		SPG	MSP	Gray			x		22	H	Brown
1	Bowl	10¼	rim		SPG	SPG	L.brn.		x	x		23	SF	Gray
9	Milk Bowl[i]	10¼	rim		SPG	SPG	L.brn.				x	24	H,HF,SF	Brown
1	Bowl?[j]	8 3/4	rim	?	SPG	SPG	L.brn.			x		25	H	Brown
2	Milk Bowl	?	5½[j]		MSPG	MSPG	L.brn.				?	26	H	Dark brown
1	Holder	?	2¼	?	MSP	MSP	Gray	x			?	27	H	Brown

a Abbreviation: R-partially or completely restored

b Abbreviations: STG-salt glaze; SPG-slip glaze; MSPG-matte slip glaze; MSP-matte slip unglazed

c Paste color names based on Munsell Soil Color Chart, Hue 10 YR

d Provenience abbreviations: H-house; HF-house floor; SF-south feature; S-surface

e Not standard colors; some colors vary over surface of vessel

f Impressed mark present "DAHLONEGA 5" see text

g Appears to match no. 18 in color and glaze and may have been made expressly for that crock.

h This holder and No. 27 may be similar in form to item no. 141 in Rice and Stoudt (1929:131). (Fig. 18K).

i May be similar in form to no. 44 in Rice and Stoudt (1929:119). Fig. 13J.

j Exhibits a raised foot

Source: Author's analysis

form reconstruction difficult. Reynolds and Schulte's forms in some case do not quite match the forms represented here. This is probably due to the differences in methods of manufacture. In order to more fully analyze the stoneware, the kiln sources should be located and the materials compared. In the 13WP22 stoneware sample an impressed maker's mark was observed which read: AYER & BRO LE I 3 (Fig. 19A). This probably is the mark of Mayer & Bro. Pottery, Eddyville, Iowa. This writer heard from locals in Ottumwa that there was a Mayer family in Eddyville making pottery, but until now there had been no substantiating data to confirm those reports. There is little additional information available on the Mayer pottery kiln. Vivian Jones of Eddyville has a complete stoneware vessel from the Mayer kiln. Unfortunately, this writer was unable to study that specimen or visit the kiln site which Mrs. Jones kindly located at this writer's request. Mrs. Jones reports (personal communication) that the Mayer pottery closed in 1892. The history of a kiln site at Dahlonega, the product of which was found at neighboring site 13WP25, is discussed in Appendix A (Fig. 19B & 19C).

In addition to specific stoneware forms described in Table 11, 112 fragments were recovered from 13WP25 which could not be form linked with specific vessels. The type of fragments and their distribution by provenience is given below:

Table 12: Distribution of Non Form-Linked Stoneware from 13WP25

	Fragment Type			
Provenience	Rim	Body	Base	Handle
House floor	1	6	1	
House		59	11	1
Surface	1		1	
South feature			26	
North well			5	

Source: Author's analysis

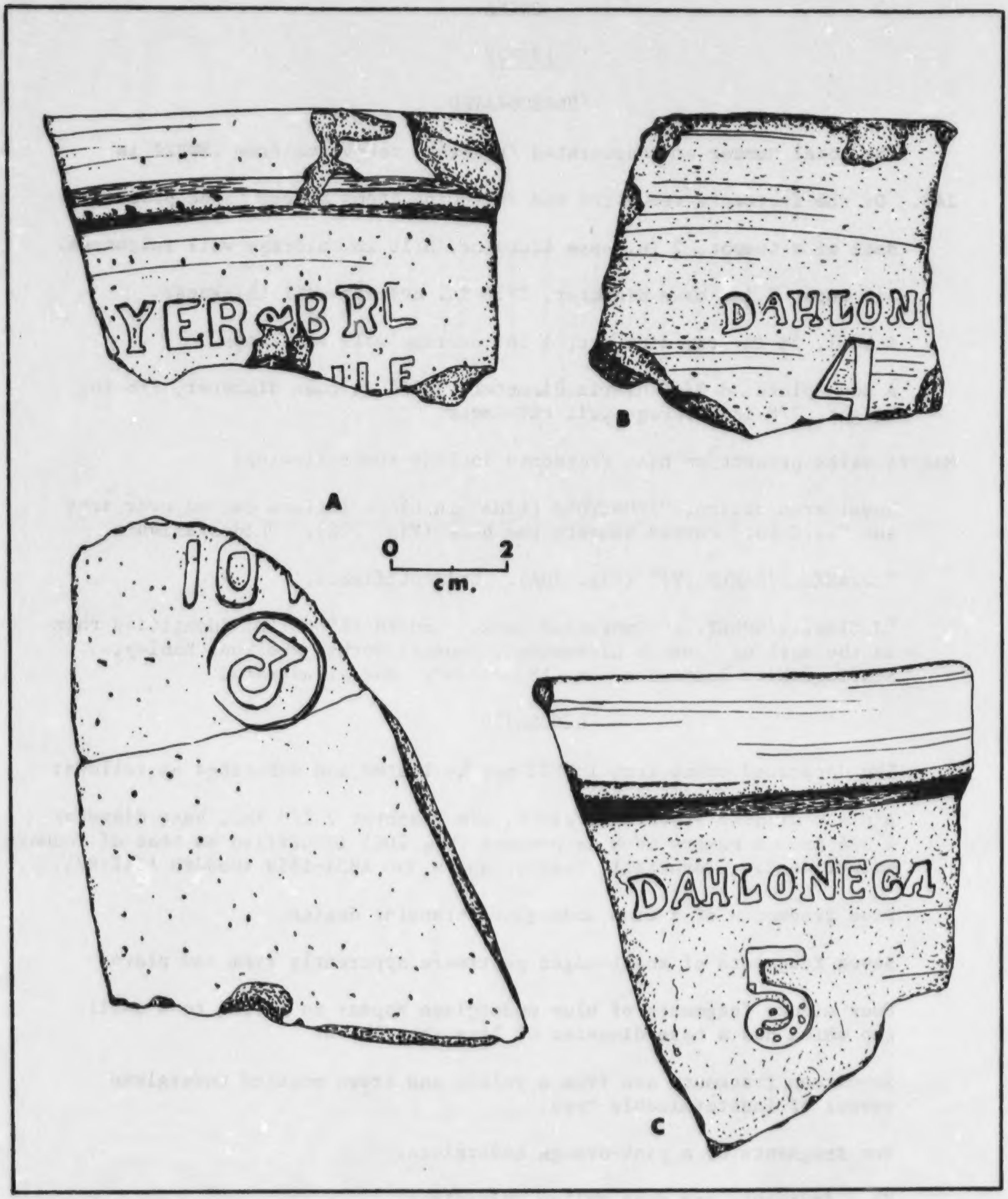


Figure 19. Impressed Maker's Marks on Stoneware. A, Mayer and Brothers, Eddyville, Iowa, from 13WP22; B, Dahlonega Stamp, 13WP107 (see Appendix A); C, Dahlonega Stamp, 13WP25.

CHINA

13WP22

UNDECORATED

The total number of undecorated fragments recovered from 13WP22 is 149. Of the fragments recovered the following items appear to be present:

Base of a teapot, 2 in. base diameter, 3/16 in. average wall thickness.

Two cups, 2 in. base diameter, 3/16 in. average wall thickness.

A bowl, 5½ in. rim diameter, ¼ in. average wall thickness.

A soup plate, 8 3/4 in. rim diameter, 3 1/8 in base diameter, 7/8 in. height, 7/8 in. average wall thickness.

Makers marks present on base fragments include the following:

Royal arms design, "IRONSTONE CHINA" in block letters curved over arms and "...E Co." curved beneath the base (Fig. 20B). Unidentifiable.

"...ANK.../HANLE [Y]" (Fig. 20A). Unidentifiable.

"J.Clem.../SHELT..." impressed mark. Godden (1964:150) identifies this as the mark of "Joseph Clementson, Phoenix Works, Shelton, Hanley, Staffordshire Potteries, ca. 1839-1864". Not illustrated.

DECORATED

The decorated china from 13WP22 may be listed and described as follows:

A plate of deep brown underglaze, rim diameter 7 1/8 in., base diameter 4 3/4 in. A makers mark is present (Fig. 20C) identified as that of Podmore, Walker, & Co., Turnstall, Staffordshire, ca. 1834-1859 (Godden 1971:82).

Five fragments of a blue underglaze transfer design.

Seven fragments of shell-edged pearlware apparently from one plate.

Four minute fragments of blue underglaze appear to belong to a small cup which has a base diameter of less than 1½ in.

Seventeen fragments are from a yellow and brown mottled underglaze vessel of indeterminable type.

Two fragments of a pink-orange underglaze.

Four fratments are deep yellow underglaze.

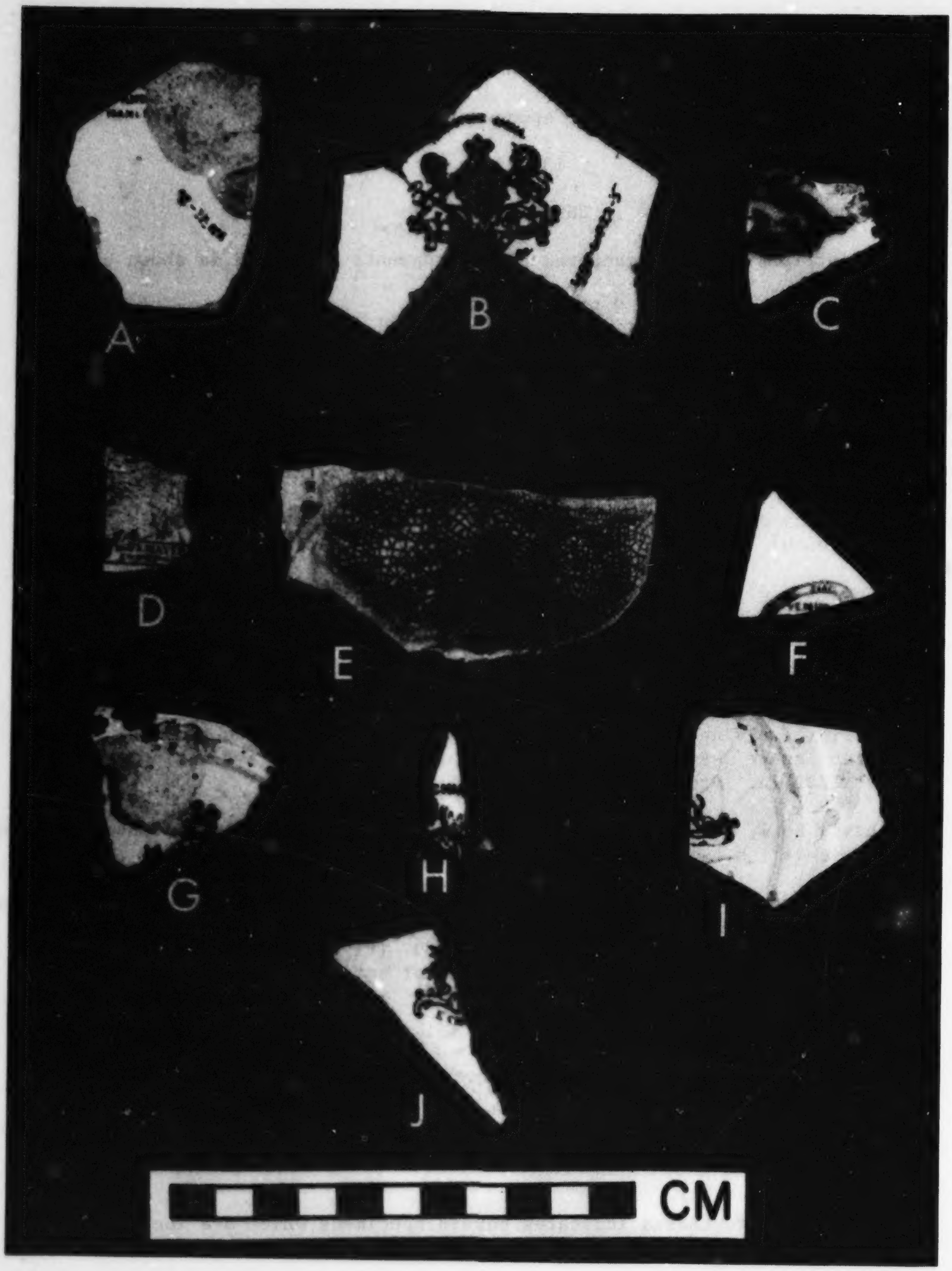


Figure 20. Maker's Marks on China, 13WP22 and 13WP25. A-C, 13WP22; D-J, 13WP25.

One fragment of a purple and green floral painted underglaze.

Three fragments are of green "spongeware."

13WP25

UNDECORATED

The distribution of undecorated china fragments recovered is shown below:

PROVENIENCES

House Floor	House	South Feature	North Well	Total
13(1)*	50 (13)	74(10)	22(1)	159(25)

Undecorated china vessels which were able to be described are listed below:

A bowl, rim diameter 6½ in., height unknown, average body thickness 3/16 in. Provenience: SF and NW.

A bowl, rim diameter 6¼ in., height 1¼ in., average body thickness 4/16 in. Provenience: NW.

A plate, rim diameter 8¼ in., height unknown, average thickness 3/16 in. Provenience: SF.

A possible serving plate, perhaps hexagonal in shape, measurements indeterminable. Embossed with relief bracket design. Average thickness, 7/32 in. Provenience: SF.

Probable bowl, rim diameter 6¼ in., height unknown, average thickness 3/38 in. Provenience: H.

Soup? plate, of ironstone, rim diameter 9 in., height, average thickness ½ in. Incomplete marker's mark showing Royal Arms and part of Ironstone China. Arms design is characteristically post 1837 (Fig. 20E) (Godden 1964: 552), but none of the dictionaries of maker's marks consulted could provide more information. Provenience: NW.

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* Number in parentheses indicates burned specimens which are included in the total fragment count.

Soup? plate of ironstone, rim diameter 9 in. height 1½ in., average thickness 3/8 in. Badly burned in house fire, no maker's mark detectible. Provenience: HF and H.

Possible base of hexagonal shape, dimensions indeterminable, average thickness 3/16 in. Provenience: SF.

Probable base of water pitcher, of hexagonal shape, estimated to be 12" in perimeter. Provenience: SF.

Cup of ironstone, rim diameter 3½ in., height 3 1/16 in., average thickness 14 in. Discoloration has occurred due to house fire. Provenience: HF and H.

The following makers marks were recovered on undecorated china base fragments:

Portion of maker's mark exhibiting a scroll pattern (Fig. 20I). Unidentifiable. Possibly from a bowl. Provenience: NW.

Portion of maker's mark displaying a circular pattern and "CHIN" (Fig. 20H). This mark was unidentifiable. Provenience: H.

DECORATED

Decorated china is represented by the following categories:

Blue shell-edge whiteware (and possibly some pearlware) is represented by twenty rims of varying types (Noel-Hume 1969). Fragment distribution*: 4 (HF); 3 (H), 9 (SF), 3 (NW), 1 (S). (Fig. 21A-21D are examples).

One cup base, blue floral design, base diameter 1½ in. Resembles porcelain in quality although this fragment is not translucent. (HF).

Twenty blue speckled underglaze fragments probably represent one cup, one saucer and one plate. Possible maker's mark "O". Fragment distribution: 2 (HF), 8 (H), 8 (SF) and 2 (NW).

* Abbreviations: HF-house floor, H-housefill, SF-south feature, S-surface, NW-north well.

Eleven blue underglaze fragments of a lily pad on a pond design representing one plate. Fragment distribution: 2 (HF), 4 (H), 3 (SF) and 2 (NW) (Fig. 21E).

Twenty red, blue and white floral painted underglaze representing one cup and saucer. Fragment distribution: 4 (HF), 5 (H), and 11 (SF).

Twelve blue and green mottled spongeware underglaze fragments representing one cup and saucer. Fragment distribution: 1 (HF), 2 (H), and 15 (SF).

Four fragments of a deep purple floral underglaze transfer pattern representing one plate. Fragment distribution: 4 (H).

One metalic "gold" banded edge fragment, probably from a plate. This fragment is from (SF).

Three black transfer underglaze fragments exhibiting a spiral design from probably one plate. A partial maker's mark is present (Fig. 20G) which has been identified as that of T.J. & J. Mayer, Longport (Burslem) Staffordshire ca. 1842-55 (Godden 1971:76).

Nine red, blue and black painted underglaze fragments arranged in parallel bands, black leaves are arranged with the red band. A cup and saucer is probably represented. The saucer is 5½ in. outside diameter. All fragments are from (SF) (Fig. 21G).

Four yellow underglaze fragments exhibiting a green and brown painted design, represent a large dish. Base diameter is 5½ in. Fragment distribution: 1 (S) and 3 (SF).

A blue printed maker's mark was recovered. The mark reads: "T...J MAYER LONGPO" (Fig. 20D). Godden (1971:76) identifies this as the mark of Thomas, John, and Joseph Mayer, Longport (Burslem), Staffordshire, ca. 1842-55.

Eight blue underglaze fragments, picturing a landscape, probably from a water pitcher and plate. A makers mark containing the name "VENUS" and "PEARL STONE WARE" is associated with this pattern (Fig. 20F). This design resembles a mark registered in 1849 by Podmore, Walker & Co., Tunstall, Stafforshire (Godden 1971:82). Fragment distribution: 3(H), 4 (SF), and 1 (NW).

Three blue painted dot underglaze design from one cup. Base diameter is 1 3/4 in. A maker's mark of two green painted dots is present. Fragment distribution: 2 from (H) and 1 from (SF).

Seventeen gray and white underglaze restorable fragments from a large ironstone serving bowl rim diameter 11 in., height 2¼ in., base diameter 8 in. Bowl is from (HF) (Fig. 21F).

Two fragments of a blue, yellow and green floral underglaze painted design probably from a plate. A maker's mark is present as a scroll

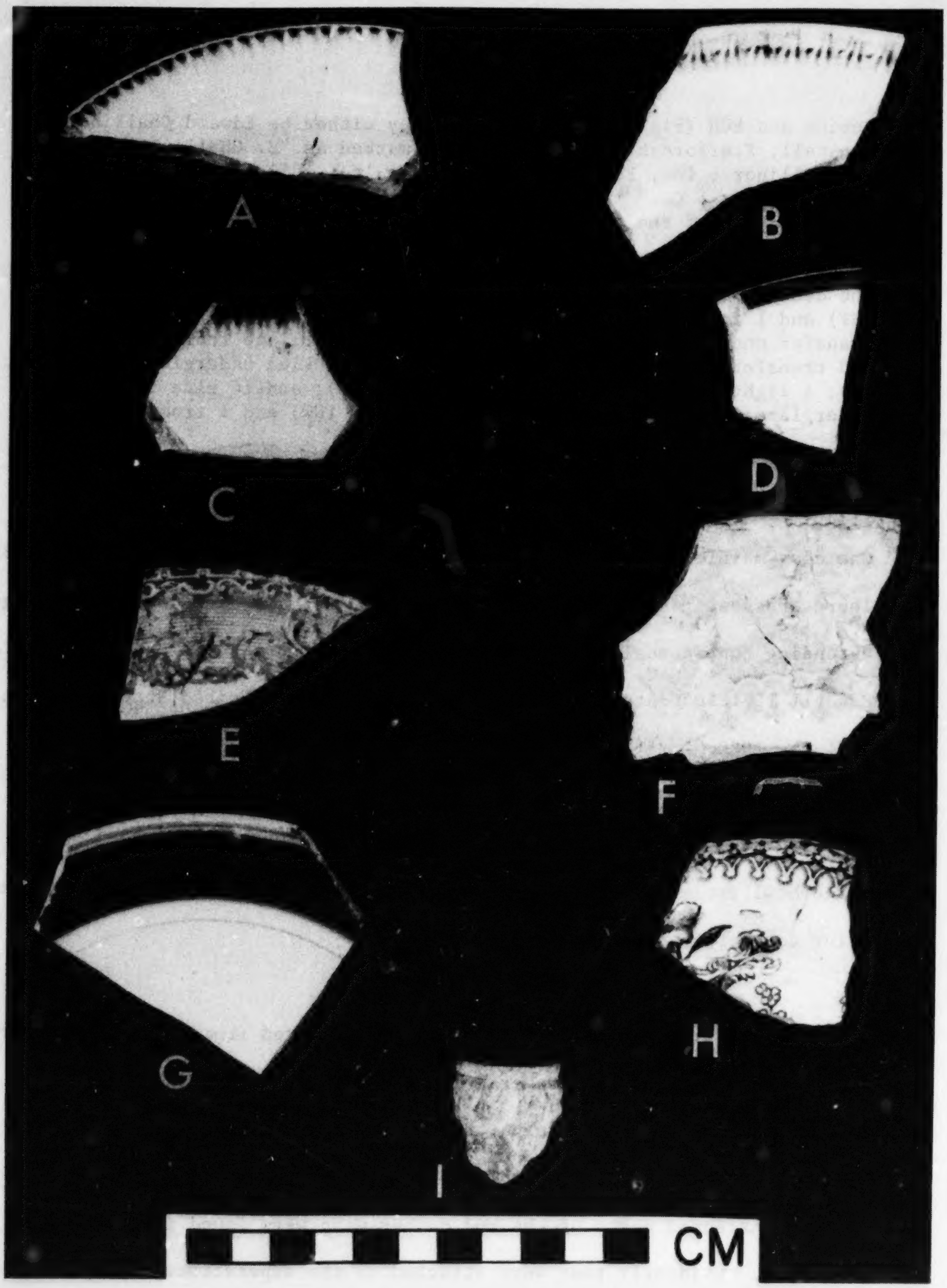

Figure 21. Decorated China Rims and an Effigy Pipe Bowl from 13WP25.

device and ECH (Fig. 20J). The maker may either be Edward Challinor, Tunstall, Staffordshire, ca. 1842-1867 marked as "E. Challinor", or E. Challinor & Co., Fenton, Staffordshire, ca. 1853-1862 marked as "E. Challinor & Co." (Godden 1971:61). Without the entire name the determination of the actual source company is difficult (Fig. 21H).

Twenty six fragments are so minute that only a brief description of the designs are possible: 4 light blue underglaze, 2 from (H), 1 from (SF) and 1 from (S); 2 black lined underglaze from (SF); 2 mulberry transfer underglaze from (H); 1 dark brown underglaze from (SF); 1 red transfer underglaze from (NW) 1 yellow speckled underglaze from (H); 1 light blue striped underglaze from (SF); and 14 blue transfer underglaze: 7 from (H); 5 from (SF), 1 from (NW) and 1 from (S).

Miscellaneous

MARBLE

One clay marble, 1.96 cm (23/32 in.) in diameter was recovered from 13WP22. There are vestiges of a decoration consisting of two dark concentric rings extending continuously around the equator. The surface is extremely pitted. Randall (1971:102) dates clay marbles produced in the United States between 1884-ca. 1920.

PIPES

One pipe stem fragment each was recovered from 13WP22 and 13WP25, and three bowl fragments including one effigy bowl from 13WP25. See Appendix B for complete descriptions.

CASTER

One ceramic furniture caster fragment was recovered from 13WP25, diameter 1 1/8 in., inside bore diameter 3/16 in. Exterior is glazed. The interior paste is very fine in particle size.

MUD DAUBER NESTS

Two fine hardened nests of the mud dauber wasp were found in the floor of 13WP25. Evidently they were attached to the superstructure at the time it burned.

BRICK

The brick from 13WP22 and 13WP25 appears to be locally made. There is much variation in the color due to firing. The 13WP22 bricks are all from Feature 3. Bricks from 13WP25 are representative of those observed.

13WP22

Eight fragments appear to be soft or underfired resulting in a friable structure and an orange color (5 YR 6/8).

One whole brick, 2½ x 4 x 8 ins., has been hard fired, exhibiting a dense, non-oorous, non friable structure and a dark reddish brown color (5 YR 3/4).

Five fragments are of overfired or "clinker" bricks, which have been fired too quickly resulting in spalling of the brick clay body. The color exhibited is a medium dark gray (7.5 YR 4/0). Portions of the outer brick surfaces appear to be glazed in a manner similar to a stoneware slip glaze. The reason for this apparent glazing is not known.

13WP25

One fairly complete soft-fired brick, 2 1/16 x 4¼ x (?) ins. Color is orange (5 YR 6/8) and structure is friable.

Two complete bricks, 1 7/8 x 3 3/4 x 7 3/4 ins., are hard fired and are similar in structure and color to those from 13WP22. One hard fired brick was observed bearing the number "462" which probably represented a batch or lot from the local kiln.

Two fragments of "clinker" bricks, similar in structure and color (7.5 YR 4/0) to those from 13WP22. However, these clinker bricks do not possess a glazed surface.

GLASS

The glassware recovered from 13WP22 and 13WP25 yielded much information. For both historic sites, the glass has been described as completely as possible with the assistance of Katie Foglesong, Ottumwa, Iowa.

13WP22

Seven fragments of an amber colored bottle exhibiting the letters: "RS", "MAC", "L", and "E". This is a probable bitters bottle, possibly "Electric Stomach Bitters" dating ca. 1880-90 (Fig. 22 A and D).

Two fragments, including a neck and base of an amber colored bottle, the base is embossed with a raised circle bearing the letters: "W... & Co. PITTS..." The letter "F" is in the center of the circle. This container could be a whiskey bottle manufactured by Wormser & Co. ca. 1875.

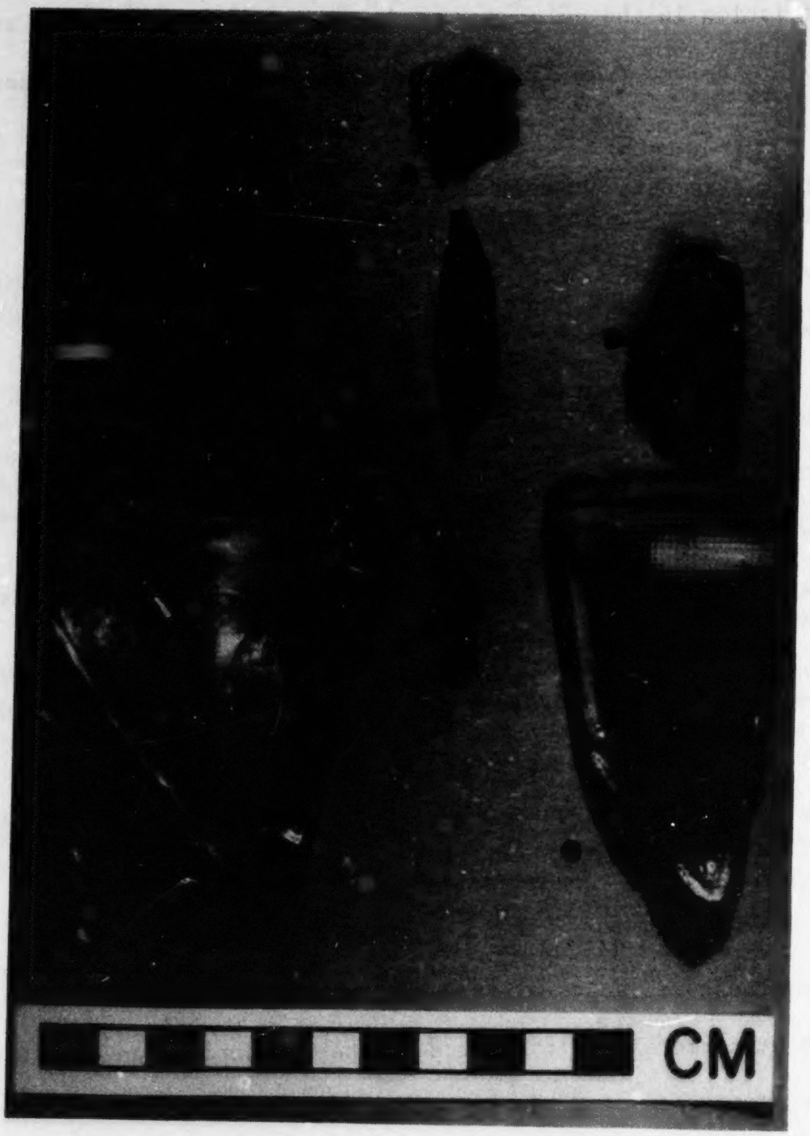

Figure 22. Glass from 13WP22 and 13WP25. A-F, 13WP22; G, 13WP25.

Four fragments from an aquamarine historical-portrait flask. One fragment is embossed with an eagle feather design. Comparable to a specimen in the Foglesong collection. Open pontils preceded the Civil War and the portrait flasks went out of vogue at the end of the Civil War. So we must assume this one was made during Civil war era before 1870 at any rate. No doubt it was made at an eastern glass house--no farther west than Ohio.

Two fragments of an unidentified item (possible bowl). The rim diameter measures 7 in. The glass is colored white and translucent, resembling milk glass but less opaque than milk glass. The exterior is decorated with solid very dark brown opaque circles, in diameter. The lip has been thickened and rounded. The vessel wall curves very slightly inward from the rim.

Five fragments of a goblet exhibiting the petal pattern, dating from 1860's to 1880's, rim diameter 1/8 in. (Fig. 22F).

Seven complete buttons and one fragment. All are 3/8 in. diameter and are white opaque except for one brown opaque specimen. Seven items are 1/8 in. in thickness except one which is 5/32 in. Every specimen is four holed.

One bead was recovered. Utilizing the classification system of Kidd and Kidd (1970), the bead may be described as follows: The bead is a tube which has been probably squared in section before drawing and in drawing the bead was twisted (as Type 1c'). The bead surface was subsequently ground into facets (similar to type 1f) and octagonally shaped. However, the Kidd and Kidd classification system does not display the exact type of bead from 13WP22. The glass is transparent and colored cobalt blue. The bead diameter and length is ½ in. (Fig. 22E).

The remainder of glassware from 13WP22 is listed in Tables 13-16.

Table 13: Bottle Necks from 13WP22 and 13WP25

umber	Neck Diameter	Color	Bottle Type	Method of Manufacture	Provenience
			13WP22		
1	3/4"	Clear	Medicine, Celery salt or household item	Mold	general
1	½"	Aquarmarine	Patent medicine	Mold	general
2	2"	Clear	Food jar	Mold	general
2	3 1/8"	Clear	Food jar	Mold	general
			13WP25		
1	7/8"	Clear	Whisky	Mold	House floor
2	1 1/16"	Clear	Liquor	Mold	House floor
1	½"	Clear	?	Mold	North well
2	7/16"	Aquamarine	Patent medicine	Mold	South feature
1	½"	Aquamarine	Patent medicine	Mold	North well
2	9/16"	Aquamarine	Bitters	Mold	Surface, south feature
1	3/4"	Aquamarine	Bitters	Mold	House
1	½"	Aquamarine	Patent medicine	Mold	House

Source: Foglesong, personal communication and author's analysis

Table 14 : Bottle Bases and Base Fragments from 13WP22 and 13WP25

Number	Shape	Size	Color	Bottle Type	Distinctive Features and/or Manufacturing Methods
				13WP22	
1	round	2 3/4" diameter	aquamarine	mineral water	Probably improved pontil
1	round	2 3/4" diameter	aquamarine	wide-mouthed food	hinged mold
1	oval	1¼" width	light colbalt blue	medicine or whisky flask	diagonal mold seam pre 1880
1	oval	1 3/8" width	aquamarine	shoo-fly whisky flask (Putnam 1965: 177)	mold
1	octagonal	2 3/4"	clear	sugar bowl, creamer, goblet, etc.	star pattern
1	square	indeterminable	clear	food jar	mold
1	round	2 3/4"	sun-purpled	jar	mold
2	square	indeterminable	clear	jar?	mold

Table 14: Bottle Bases and Base Fragments from 13WP22 and 13WP25 (cont'd).

Number	Shape	Size	Color	Bottle Type	Distinctive Features & Manufacturing Methods	Provenience
			13WP25			
1	hexagonal	?	sun-purpled	whisky	mold	house
1	oval	?	aquamarine	elixer or bitters	improved pontil	house
1	round	8 cm (3 1/8 in.) diameter	aquamarine	?	pontil mark	south feature
1	round	?	aqumarine	?	pontil mark	house
1	oval	3.5 cm (1 3/8 in.)	aquamarine	elixer or bitters	improved pontil	house floor
1	oval	?	aquamarine	"	hinged mold	house
3	square	3.9 cm (1½ in.)	aquamarine	?	mold	house floor; south feature
1	round	8 cm (3 1/8 in.) diameter	aquamarine	wine ?	mold	house

Source: Foglesong, personal communication and author's analysis

Table 15 : Lettered Glass from 13WP22 and 13WP25

Number	Color	Item Description	Lettering or Decoration
			13WP22
1	Aquamarine	bottle face	MSAM M/MSM
1	Clear	table ware	stippled background and raised leaf ca. 1880-190
1	Clear	table ware-dish	raised curvilinear pattern-mold blown
			13WP25
1	Crystal	bottle face and base corner	AL/Co./Dayton
1	Aquamarine	bottle face	OR/ES
1	"	" "	C'S C/DIS
1	"	" "	REEN
1	"	" "	DR. C
1	"	" "	85*

*Probable patent date 1885

Source: Fogelsong, personal communication and author's analysis

Table 16: Miscellaneous Glass Fragments from 13WP22 and 13WP25

	13WP22	13WP25 Provenience				
Color		House Floor	House	South Feature	North Well	Surface
Clear	10	35(6)	14 (2)	6 (1)	2	
Amethyst (sun-purpled)			15	1		
Aquamarine	4	52	59	15	5	1
Windowglass	12	3	9	2	3	
Milk glass			3			
Light Cobalt Blue	1					
Lime Green	3					

Source: Author's analysis

13WP25

Bitter's bottle labelled in relief on the base "J. Walker's VB." (Watson 1965: 274) describes a bottle of this style as Dr. Walker's Vinegar Bitters (L 140) sold during the period 1870-1906. This bottle is: mold made, circular in horizontal cross section, conical shoulder aquamarine in color, has an applied lip, is 8½ in. high, and has a base diameter of 3 in. This is the only intact bottle which survived the house fire and was not broken or melted. Provenience: HF.

Four fragments of a quart champaign beer bottle, mold probably no. 15 or 16 (Putnam 1964:253). A rust ring on the neck indicates presence of lightning stopper. The color is aquamarine, circular in shape and is mold made. The bottle is partially melted and unable to be restored. The neck is finished in a bulbous style 14 (Switzer 1974:8, Fig. 2). Accoring to Putnam (ibid.) this bottle probably stood 11¼ - 11½ in. high, was 3½ - 33 5/8 in. wide, held 28 oz. of liquid, and weighed the same amount. The lightning stopper, which was patented in the U S in 1882 (Lorrain 1968:42), dates this bottle between 1882-1906. Provenience: HF.

Ten fragments of a soda or mineral water bottle, probably mold no. 222 (Putnam 1965:240). 7 1/8 in. projected height, bulbous neck finish style 14 (Switzer 1974:8, Figure 2), conical shoulder, chilled iron mold made, aquamarine color, base diameter 2½ in. The heat of the house fire has melted portions of fragments just enough so that the bottle will not entirely resore. Time period 1870-1906. Provenience: HF.

Two fragments of a bottle of Dr. D. Jayne's Expectorant, Philadelphia, ca 1867. Identified from "AD" of Philadelphia embossed on bottle side. The bottle has a hexagonal base and is aquamarine in color. Provenience: HF.

Five fragments of a bottle of Dr. Harter's Elixir of Wild Cherry, (Dayton, Ohio?). Improved pontil mark on oval base, and a horizontal seam across base indicating use of a hinged mold date this bottle 1862-1868. This bottle is two-piece mold made and displays a style 10 neck finish (Switzer 1974:8, Fig. 2). Glass color is aquamarine. Provenience: HF.

Two fragments of a patent medicine bottle perhaps containing a liquid such as children's soothing syrup. An "A" is embossed--very likely as in U S A. A likely possessor of such a lettering is: THE LITTLE DOCTOR/MICROBINE MEDICINE CO./ NEW YORK U S A. This bottle dates probably 1860-1900, more likely before 1900. Proveniences: HF.

Five fragments, including three neck, of hexagonal whisky flasks which probably are Shoo-fly flasks (Putnam 1965:179). They are mold blown, the neck and lip have an added ring which dates ca. 1890. The glass is clear but some sun purpling has taken place. Provenience: HF.

Nineteen fragments of Bourbon Bitters bottle similar to illustration L19 in Watson (1965:251). His description (Ibid.) is as follows: "Shows a seated woman and has a fancy border around the edge. Dark yellow amber three piece mold, push-up base with letter 'p', 9 x 2½ ins. Some fragments of this bottle have been melted and partially fused. The type of bottle was identified from fragments exhibiting letters "URBO" and "RS". Fragment distribution: 8 (HF), 5 (H) and 6 (SF).

Eighteen fragments of a dark green wine bottle dating 1870-1900. The bottle fragments have been partially fused by fire. Fragment distribution: 14 (HF) and 4 (H).

A small cosmetic bottle which probably held cosmetic cream or powder; the four pointed star design and label space indicates that this was not intended for common condiments, dating pre 1900. Provenience: SF.

One fragment of a small hand mirror or picture frame glass. Provenience: H.

One eyeglass lens, shape dates within 1860's. Provenience: NW.

One fragment of sugar bowl, spooner or goblet with "stipled forget-me-not" design popular during late 1870's through 1880's. Provenience: H. (Fig. 22G).

Green bottle base with embossed "G-94/Duraglas" mark of Owens and Illinois Glass which merged in 1920's. Provenience: H.

One clear goblet fragment exhibiting the petal pattern, dating 1860's to 1880's. Provenience: SF.

Two fragments of an octagonal milk glass lamp base, dating ca. 1890. Provenience: H.

Six fragments of a blue-green bottle with a base bearing a pontil scar which dates before 1857 (Lorrain 1968; 40) and certainly before 1865. Provenience: SF.

Two fragments of threaded jar rims. Provenience: H.

One fragment of a clear food bottle displaying a banded and fluted design, pre-1900. Provenience: HF.

Two clear bottle bases dating from the 1920's and 1930's. Proveniences: H and S.

Bottle necks and bases, lettered glass fragments and miscellaneous glass fragments are listed in Tables 13-16.

METAL

Metal items recovered are listed below. Sources useful for identification were unavailable, hence, little more than a brief description is presented. Small metal items are listed in Table 17. Items were categorized as: domestic, i.e., household related; craft/artisian implements, i.e., farm implements or other labor related; and miscellaneous implements.

13WP22

DOMESTIC

1	Three holed tie piece 15/8" square
1	Hinge 2½ in. in length, each half 1 in. in width.
2	Hinges 3 in. in length, each half 1 in. in width.
1	Partial spoon apparently plated; the bowl and handle portion are fragmented.
1	Partial leg such as for a cast iron skillet (Fig. 23 A).
1	Partial leg such as for a fireplace grill or stove
1	Bucket 10¼ in. rim diameter, average thickness 1/16 in. badly fragmented.
1	Round handle 2¼ in. in length attached just below the lip.
1	Curved hook with rivets probably indicating the presence of a handle.

CRAFT/ARTISAN

1	Cow kicker
1	Machinery foot stirrup.
1	Hammer-hatchet 5¼ in. in length.
4	Chain links each 2in. length.
1	Possible machinery hitch bar
1	Single tree harness piece

Table17: Distribution of Small Metal Hardware Items

			13WP25					
Dimension Inches	Penny-weight	13WP22	House Floor	House	South Feature	North Well	Figure	Comment - Possible Use
				Cut Nails				
1 length	2 d	7						
1¼ "	3 d			1				Finishing?
1½ "	4 d	11	1	6	1	5	24I	Framing, siding
1 3/4 "	5 d	5		15		2	24G	
2 "	6 d	16					24F	light framing
2½ "	8 d	24	3	35		11	24E	light framing
3 "	12 d	6	1	17		3	24C	Framing
4 "	20 d	1	2	2		1	24B	Heavy framing
				Thin Nails (cut)				
1 1/8 "			1				24K	Barrel (round headed)
1½ "					2		24H	Finishing? " "
1½ "				2			24L	Roofing
1 3/4 "								Metal finishing tack
				Spikes				
2½ "		2		3				Heavy framing
3 "		2						" "
3 3/4 "		2	5	3	2			" "
4 "						1	24A	" "
5½ "	railroad	7						
				Wire Nails				
3 "	12d			1				Framing
				Screws				
1		2						
1 3/4		1						

Table 17: Distribution of Small Metal Hardware Items (cont'd).

Dimension Inches	13WP22	13WP25				Comment - Possible Use
		House Floor	House	South Feature	North Well	
				Square Washers		
2 5/8 square		1				Hand cut
				Round Washers		
3/8		1				Copper
3/4		1				
1 3/4 diameter		2	1			
1 13/16 "			1			
2 "		2				
2 1/8 "		1				
2¼ "		1	1			
2½ "		1				
				Nuts		
1	1					
1½	1					
2 5/16 square			2			
				Bolts		
3" length					1	
4" "	1					
4 3/8 "			1			
5 "	1					Drop pin in a hitch
6 "	1					Drop pin in a hitch
15 " (½in. diameter)			1			
17 " (3/4 - 1 in. diameter)			1			
				Wire Fragments		
Variable length, each 1/16in.width		4	10	8		
				Miscellaneous Metal Fragments - Unidentifiable		
		4	11	12		

Source: Author's analysis

13WP25

DOMESTIC

1 Shotgun hammer assembly (see Appendix D)

1 Copper button shell, ½ in. rim diameter, fastener threaded through hole in center. The name "Scovills & Co. Extra" is stamped around the rim. The name of the firm impressed on this button has undergone some change through time. As Albert and Kent(1949:405)note, the firm of "Leavenworth, Hayedn and Scovill, Waterbury, Conneticut... bought out Abel Porter Company in 1811. Firm name changed to J.M.L. & W.H. Scovill in 1827. Became Scovill Manufacturing Company in 1850. Still in operation." The fact that the impression is "Scovills & Co." and not "Scovill" leads the writer to date this button case between 1827-1850. Provenience: H.

CRAFT/ARTISAN

2	Axle stays, used to keep the wheels on wagon axles; they are metal rings with an outside diameter 1/8 in., inside diameter 3/8 in. (HF).
4	Horseshoes 1 (HF), 2 (H) and 1 (NW)
7	Wagon wheel guard fragments, 6 fragments are 1 in. in width. 3 (HF) and 3 (H), and 1 fragment is 5/8 in. in width (NW).
2	Partial sickles, the first fragment is 43 in. in length and 2 3/8 in. in width, the second fragment is 20 1/8 in. in length and also 6 cm in width. Each fragment exhibits a handle. (HF)
1	Partial brass sleigh bell (SF)
2	Circular harness buckles 3½ in. in diameter with a cross piece bisecting the buckle. (NW).
1	Circular solid ring 2 in. in diameter with central threaded socket, possibly from a wagon (H).
2	Partial corn planter checker plates - two types are present: 1 9½ in. diameter, 5/8 in. hole diameter, holes are spaced 3/16 in. apart around 3/16 in. apart around the plate rim (H). Fig. 23E). 1 9 in. diameter, ¼ in. hole spacing, alternating 3½ in. oval and ½ in. holes spaced around the plate rim (H). (Fig. 23F).
2	Buggy or wagon straps and springs with U nails for attachment (H)
1	Cow bell 5 3/8 in. length, 3 3/4 in. at shoulder, 4 3/4 in. at base. Bell has a hanger attached, clapper is missing. Bell has been flattened somewhat. (HF).

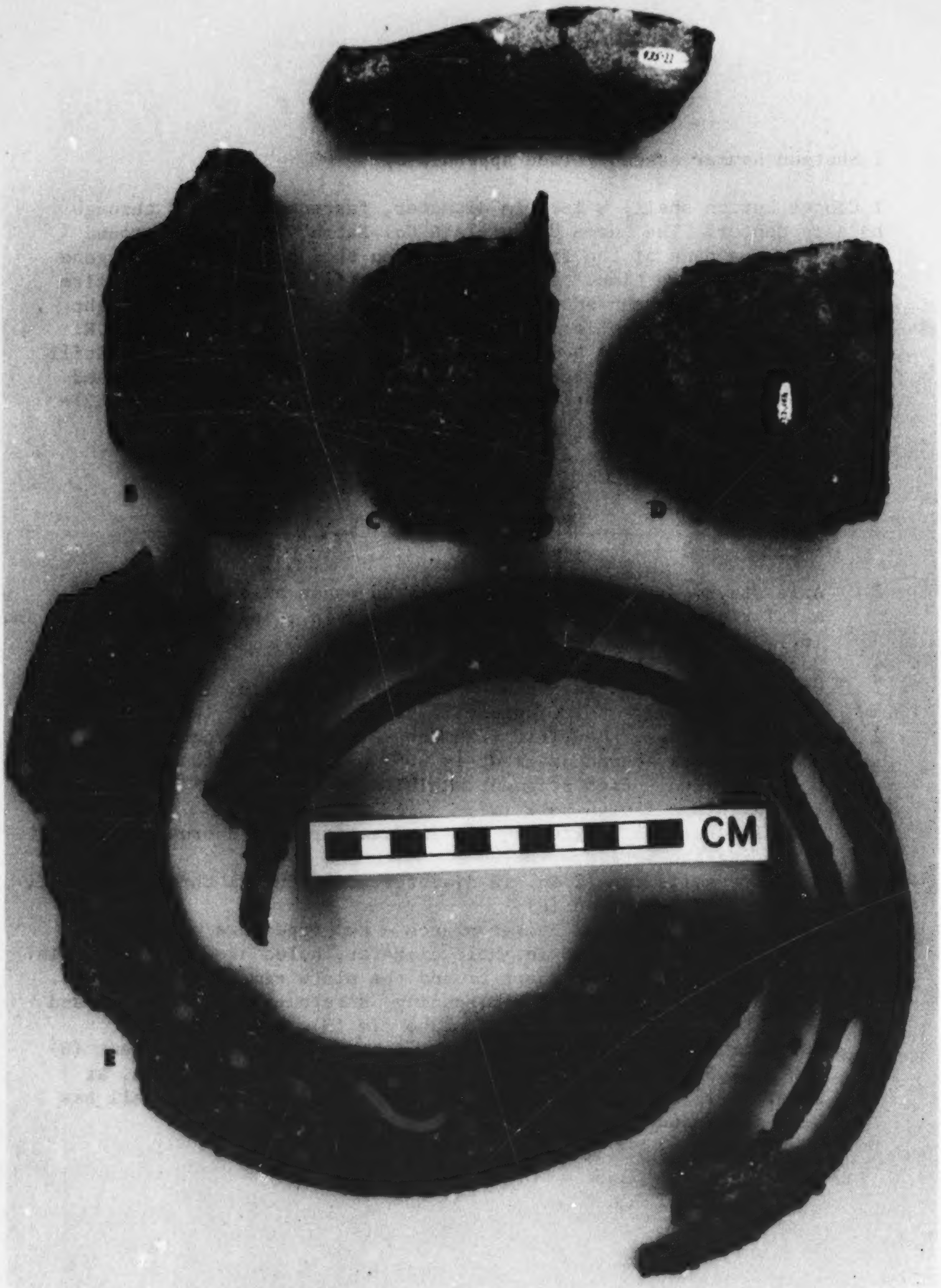

Figure 23. Metal Items from 13WP22 and 13WP25.

NON-CATEGORICAL

1	Bar 9½" in length, 7/8" in width, convexly shaped on one side expanding to a thickness of 1/8"
4	Unidentifiable cast iron fragments
1	Small bar, elongated U shaped, 1 3/16" in length, 1/16" in diameter - possible belt buckle fragment.

13WP25*

DOMESTIC

1	Kerosene lamp wick holder (H)
2	Kitchen stove ash grate (HF)
3	Drawer pulls (HF) (Fig. 23B, 23C).
1	Door latch and handle assembly (HF)
21	Bucket pieces 1/16 in. thick 13 (HF), 5 (H), and 3 (SF)
10	Bucket pieces 3/4 in. thick (SF) one piece is marked with an embossed "I"
1	Complete bucket handle with a looped center for hanging or tying complete with rivet assembly (HF)
2	Cylindrical window counter balances 6 in. long and 2½ in. in diameter 1 (HF) and 1 (H).
1	Probable cupboard handle
5	Spoon fragments including 3 bowls. 1(H) and 2(NW)
1	Perforated end handle (H)
1	Plain handle stamped with a maker's mark: C & S, (NW). (Fig.24N).
1	Stove firebox knob (H)
2	Hinge fragments and 1 complete hinge (H)
3	Door lock assemblies (H) (Fig. 23 D is an example).
1	Drawer lock plate (SF)
1	Door lock plate (H)
1	Strap hinge (H)
1	Belt buckle (H)
2	Garter or suspender buckles (H)
1	Copper boiler lid, partially fragmented (HF)
1	Wrought iron (fence top?) decoration (H)
29	Barrel hoop fragments

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* Provenience abbreviations: H-house; HF-house floor, SF-south feature, NW-north well, and S-surface.

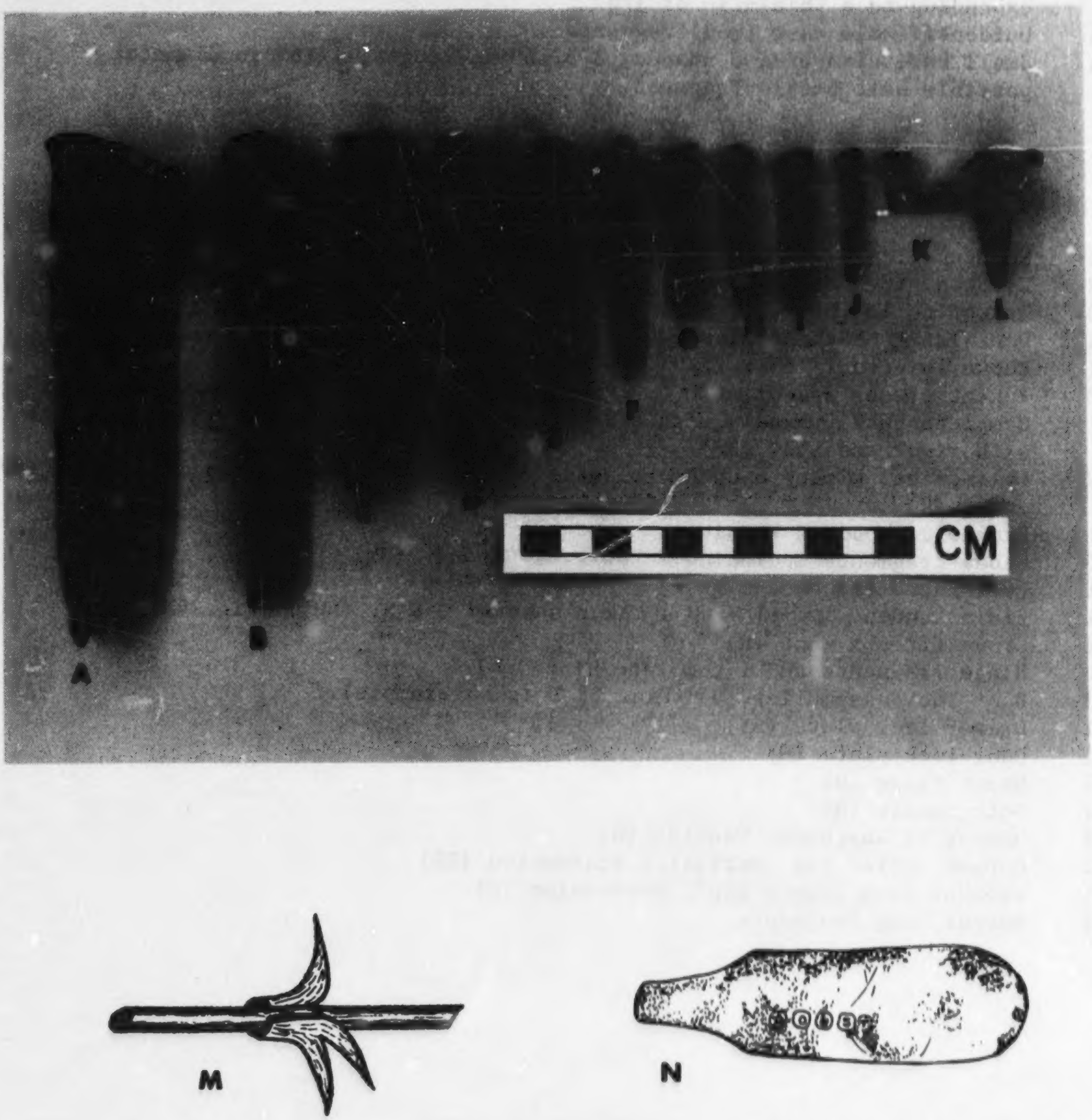

Figure 24. Small metal items from 13WP22 and 13WP25. A-L, nails; M, Kennedy's Barb, three-point variation (from Clifton 1970, No. 211); N, spoon handle impossed with "C & S."

1 piece of barbed wire appears to be Kennedys Barb, Three point Variation which is described as a single-strand wire with three-point sheet metal barb. Barb is hand mounted. Variation of patent 153965 (Clifton 1970:74). The date of patent 153965 is August 11, 1874 by Charles Kennedy of Hinckley, Ill. (Clifton 1970:76). (Fig. 24M).

6	Chain links 1½ in. outside length of individual link (HF).
1	Axe head, butt length 3 9/16 in., butt width 1 3/8 in., body length to greatest width on bevelled end 7 1/8 in. (NW).
5	Sickle mower blades, 3 (HF), 1 (H) and 1 (NW).
1	Axle shaft cap? 3½ in. outside diameter (NW).
2	Hooks (H).
1	Wheel guard washer and nail assembly (H).
1	Flat bed machinery support. (H).
1	Three prong pitchfork, center prong broken, overall length 12 in.(H).

NON-CATEGORICAL

1	Bar 21½ in. length, 9/16 in. diameter (HF).
1	"U" shaped strap, 2 in. in width and 24 in. in overall length (H)
1	Bar 1 in. in width, 13½ in. in length (H)
1	Bar 3/8 in. diameter, 1 ft. length, "L" shaped bend at both ends (HF)
2	Wire ovals 3 7/8 in. in length and 1 3/4 in. in width. (H).
1	Double open ended copper tube 1 1/16 in in length (H).

LEATHER

Seven fragments of a badly decayed shoe were recovered from 13WP25.

The following parts are recognizable:

2 fragments from one nearly complete sole. The length is ca. 8 in., width is ca. 3 in. at the instep. The outsole is fastened to the insole by small brass screws. Anderson (1968:59,64) dates this construction as occurring after 1862.

FAUNAL MATERIAL

Description and interpretation of this material is presented in Appendix C.

Discussion

While the scope of this report is primarily descriptive, the historical research conducted and the material recovered will provide useful data for future investigation and interpretation. Both sites are unique archaeologically and the materials recovered are worthy of further study.

Judging from the mean date of diagnostic china and glass, 13WP22 was an active sawmill ca. 1875. As might be expected, most artifacts recovered fall into the utilitarian category. At 13WP25, there is evidence to suggest that most of the materials recovered date from the McQuiston occupation of the house. The mean date of diagnostic china, glass and metal can be set at ca. 1862. Since the records indicate that McQuiston took out a mortgage on the land in 1869 and a structure is shown on the property by Warner (1870); one assumes that he brought many of his possessions with him. The occupational debris may, therefore, be representative of a rather short occupation as McQuiston is known to have lost title to the land in 1871. One beer bottle (1882-1906), one piece of barb wire (1874) and various bottle fragments (1920-30) may have been introduced at a later time, assuming that the house cellar was open for a period of time after the house burned.

The apparent tight cluster of artifacts found within the house fill, well and south feature indicate that the structure may have burned at the close of the McQuiston occupation indicating that subsequent tenant farmers lived elsewhere. Artifact patterns at both 13WP22 and 13WP25 are consistant with what one would expect to find considering the time of occupation and social position of the occupants. Materials recovered were basically utilitarian in nature. At 13WP25 there is an indication from the faunal analysis that wild as well as domestic animals were taken. The absence of deer is noteworthy (see Appendix C), perhaps suggesting that hunting was less important to the economy of the McQuiston family than the use of domesticated animals. Judging from the farm implements,much of the family's economy was based upon crops raised. Perhaps as more is learned through the excavation of other sites of this time period the assemblages from 13WP22 and 13WP25 will be of greater interpretive value.

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Appendix A: A History of the Potters in Dahlonega, Iowa

During the Phase II investigations at 13WP25 a stoneware rimsherd was recovered bearing the impressed stamp "DAHLONEGA" / "5". This sherd aroused the writer's curiosity and research was initiated to determine the date and place of manufacture, and identity of the manufacturer.

County histories were consulted initially. The Western Historical Company (1878:539) relates that in 1856 "...the records show...an extensive pottery...." Waterman (1914:315) stated that: "in the early days there was a pottery shop, long operated by L. F. Stewart, not quite a mile west of the town of Dahlonega." Waterman (ibid.) apparently referring to sometime in the 1850's notes that "in the town of Dahlonega there was also a pottery shop here about this time, run by one Haswell." These brief references formed the basis for further inquiry.

Iowa state gazetteers were next examined. The earliest, Hair (1865:593), listed a potter in Ottumwa, John P. Williams, but none in Dahlonega. R. L. Polk (1882:1088) entered as a subscriber "Underwood--Dahlonega." No subsequent listing of any pottery in Dahlonega was noted in state gazetteers from 1884-1922.

The 1856 census of Iowa (Iowa Census Board, 1856 ms, vol. 65: 119, 139) lists the following potters in Dahlonega township:

Name	Age	Years in Iowa	Place of Previous Settlement	Land Ownership
L. T. Stuart	32	9	Indiana	Yes
James Smith	23	13	Indiana	No
James W. Catterson	24	1	Kentucky	No
John Reece	33	9	Pennsylvania	?

L. T. Stuart is apparently the potter referred to in Waterman (see above).

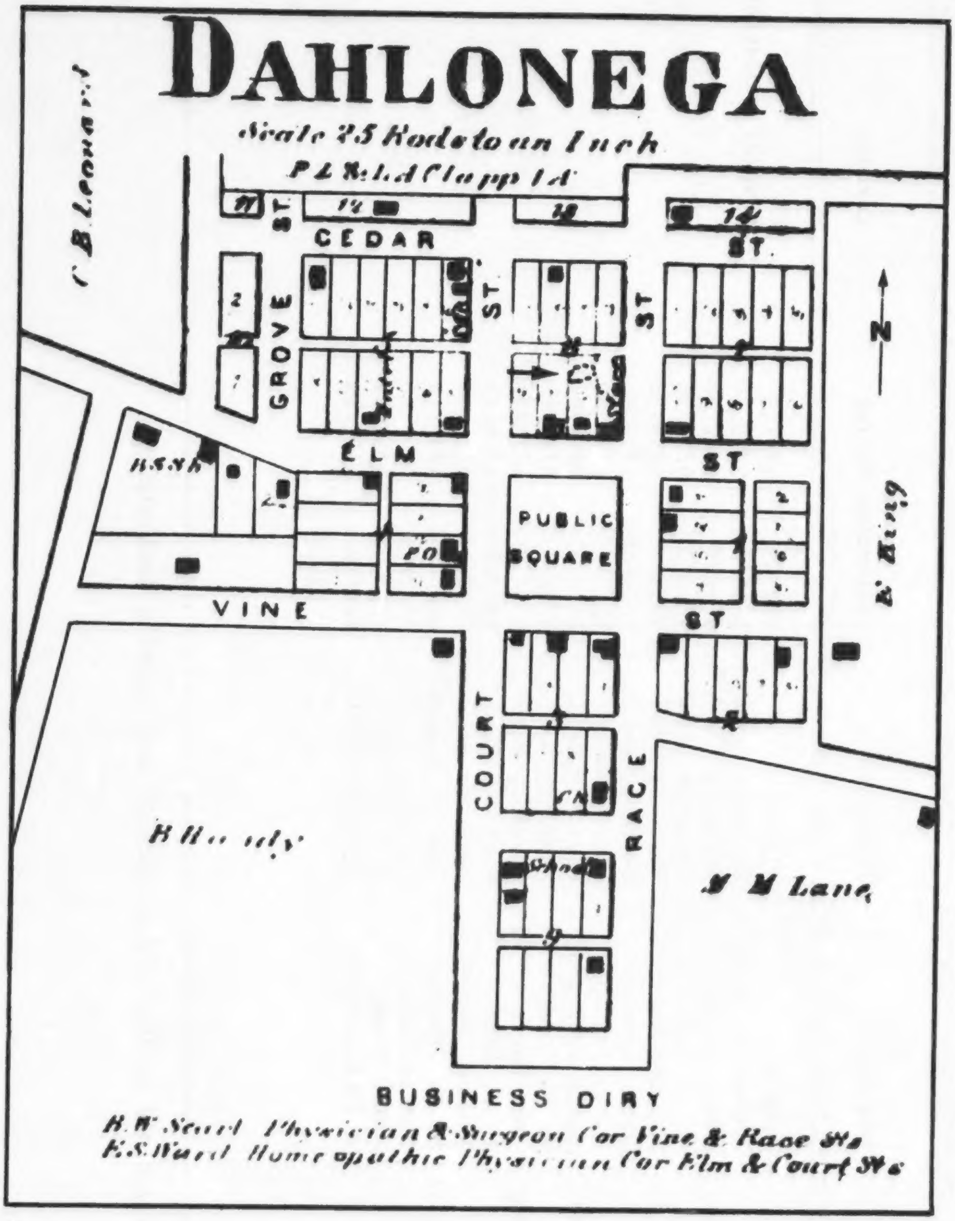
A brief ground inspection of the town of Dahlonega produced an apparent stoneware waster (refuse) pit which contained kiln furniture similar to the types discussed in Reynolds (1969 ms) and Schulte (1974 ms). This waster pit produced a stoneware rim exhibiting an impressed stamp comparable to that from 13WP25 (Fig. 25). The location of this waster pit is in Dahlonega, Block 6, West one-half of Lot 6 (see Fig. 25). The Dahlonega plat book of McElroy, Truitt and Truitt (n.d.b.) was searched for the above location, the results of which are displayed in Table 18 . The name of L. T. Stewart appears and apparently owned property in this location from April 13, 1853 to September 29, 1856 when he relinquished his deed.

L. T. Stuart's (or Stewart) name did not appear in any subsequent land transactions in Dahlonega or Dahlonega township. Stuart apparently had moved from Dahlonega. His subsequent domicile was a matter of speculation until examination of Iowa state gazetter of R. L. Polk & Co. (1883:1088) for 1882-83, and 1884-85 (1885:1303) revealed "Stuart & Burley, Blakesburgh." At first I was not certain whether the Stuart listed was L. T. but the Polk gazetteer for 1889-90 (R. L. Polk 1890:1438) verified this.

A stoneware crock in the Wapello County Historical Museum is stamped with the name Blakesburg impressed in a lettering style similar to that found on the Dahlonega ware, strengthening the contention that the same man, Stuart, was responsible for both. Further evidence should be obtained by comparing material from the Blakesburg kiln with that from Dahlonega.

Now that L. T. Stuart has been identified, what of "one Haswell?" Haswell is not listed in the census for 1856 but he is listed in the tax record for 1857 (Wapello Co. Recorder's Office 1857: no page) as Nathaniel Hoswell residing at Lot 6, Block 4, and having $2.50 in delinquent taxes due. This is the only record observed on Hoswell. Apparently he roomed fairly close to the location of the waster pit. Unfortunately there was no direct evidence that Hoswell ran the pottery shop for Stuart other than the reference in Waterman (ibid.).

Figure 25: Location of the Stuart Waster Pit, 13WP107



◌ = 13WP107

Source: Warner 1870 and author's analysis

Table 18. Transfer of Land in Dahlonega, Iowa, Block 6, West One-half of Lot 6 and Lot 7

Grantor	Grantee	Instrument	Dates Instrument	Filing	Comment
John Moore	Public	Plat	4/2/45	4/3/45	
John Moore	Thomas G. Givin	Warranty Deed	1/26/48	4/15/48	Founder - platted all blocks
Thomas G. Givin	James Broherd	Warranty Deed	9/5/49	2/22/50	
James Broherd	L. T. Stewart	Warranty Deed	4/13/53	9/29/56	
L. T. Stewart	Wm. Shoemaker	Warranty Deed	9/19/56	9/29/56	
Wm. Shoemaker	James Reesman	Warranty Deed	3/24/58	1/3/59	
James Reesman	J. C. Johnson	Warranty Deed	12/31/58	4/20/60	
M. M. & Caroline Lane	Louis Goehring	Warranty Deed	2/28/67	8/9/70	
John & Mary Garlock	A. H. Cooper	Warranty Deed	5/8/71	5/8/71	
Lewis & Ellen Goehring	John Garlock	Warranty Deed	8/9/70	1/25/71	
Amos & Mary West	M. M. Lane	Warranty Deed	4/7/72	1/24/73	
W. C. Grimes	Vinson Perkins	Returned Exchange	3/30/74	4/25/74	
T. P. Spilman (sheriff)	W. C. Grimes	Sheriff's Deed	4/25/74	4/30/74	
W. C. Grimes	Reeder Fish	Tax Sale	10/2/76		
E. S. & Mary Ward	Julia Clapp	Warranty Deed	9/13/94	9/18/94	
Julia C. Clapp	R.J.&A.L. Speer	Warranty Deed	4/1/20	4/12/20	

Source: McElroy, Truitt and Truitt, n.d.b: 105-107 and author's analysis

In the period after Stuart left Dahlonega, a potter from Ohio, John Richards, was in town in 1870 (Iowa Census Board, 1870 ms, Wapello Co:390. Nothing further is known concerning Richards, either before or after 1870. He may not have been a land owner or a resident as he is not listed in the land transfer books and does not appear to be connected with the location of the Stuart waster pit.

L. T. Stuart has been traced fairly satisfactorily. However, the potter "Underwood -- " listed in Polk(1882)is still an enigma. As Underwood is not listed in state gazetteers of the late 19th century, Ottumwa city and Wapello county directories were examined. Merritt and Goodwin (1886) list a J. H. Underwood & Son pottery on Richmond in Ottumwa (p.146); and J. H. and F. E. Underwood are listed as residing on the same street (p.113). Sutton Publishing Co. (1887) contains the following information: Potter Fred E. Underwood, residing on the north-south state road, south side (p.187); Joseph H. Underwood, same occupation and address as Fred E. (p. 188); the South Ottumwa Pottery Co., J. H. Underwood, proprietor, located on the north east corner of 2nd and Ferry, also on the south side (p.216); and a note that Joseph H. Underwood owns lots in Dahlonega (p.266). No author (1890) enters F. E. Underwood as working in Morrels Meat Packing Plant and residing at 315 Ward Street in 1890-1891. F. E. Underwood, Cooper, and J. H. Underwood, propietor of pottery works reside on the north side of Richmond are, south side of Ottumwa (no author 1892:187) and Underwood's pottery works are at the corner of Ferry and Richmond (Ibid.: 249). The Underwoods are not listed in subsequent city directories. A newspaper article in a scrapbook (No Author 1891:7) mentions" J. H. Underwood; pottery; located in South Ottumwa ten years.)

The Census of 1885 (Iowa Census Board, 1885 ms, Wapello Co.: 210-212) list the following potters in South Ottumwa:

Name	Age	Place of Birth	
J. H. Underwood	53	Ohio	same household
Fred E. Underwood	18	Union Co., Iowa	
Howard E. Sowers	28	Ohio	
Burt Weingardner	27	Des Moines Co., Iowa	same household
Thomas B. Franklin	26	New York State	
August W. Melcher	42	?	

The Special Census of Ottumwa (Ottumwa City Council 1891; Fifth Ward: no page) lists J. H. and Fred E. Underwood. But by the 1895 Census (Iowa Census Board 1895 ms) the Underwoods have apparently moved, as they are no longer listed.

In sum, until further evidence can be gathered, a tentative date of 1853-1856 may be assigned to Stuart's pottery kiln in Dahlonega, after which he probably moved to Blakesburg where he was in operation until about 1890. In the meantime, potter John Richards was in Dahlonega in 1870, but the location and extent of his stay there is not known. As for the Underwoods, they seem to have moved to Wapello County from Union County, Iowa (where Fred Underwood was born). Apparently, Joseph Underwood started his pottery in 1881, either in Dahlonega or South Ottumwa. (He may have had an outlet in Dahlonega) but by 1886 the Underwoods were running the South Ottumwa pottery works and the only connection with Dahlonega was ownership of lots there by Joseph H. Underwood. The Underwoods continued to run the South Ottumwa works until at least 1892 after which no mention is found of J. H. or Fred E. Underwood in either directories or census records.

The location of the Underwoods' pottery works in South Ottumwa should be determined, as should Stuart's in Blakesburg so that the material can be collected and compared with that from the Dahlonega waster pit (13WP107), 13WP22 and 13WP25. It is important to know the extent of traffic of items from local kilns such as those of Dahlonega, Blakesburg, and South Ottumwa in order to trace economic networks in the 19th century Iowa.

Appendix B: Analysis of Clay Tobacco Pipes from 13WP22 and 13WP25

Margaret Hotopp, Department of Anthropology
University of Iowa

Clay tobacco pipes are found in abundance in American historic archaeological sites, especially the sites of old forts. Large numbers of the fragments have been recovered from Fort Laramie, Wyoming; Fort Union, New Mexico; Fort Pierre II, South Dakota; and Fort Atkinson, Iowa. This abundance must be due in part to the extremely low cost of the pipes, "varying . . . from 50 cents to $1.20 per gross" (Wilson 1961:123). The low cost was the result of the industrial revolution in Europe which mechanized pipe production in the middle eighteenth century. The first clay pipes were introduced in Europe during the sixteenth century, possibly by the British, who were prohibited by the Spanish from obtaining the preferred Havana cigar. Hence, most tobacco imported by the British was in the form of leaves. Since professional cigar rollers were rare in Britain, the most desirable alternative was to smoke the shredded product in a pipe (Humphrey 1969:13). The earliest reference to pipes in England appears to be that of William Harrison, who, in 1573, described the practice of "the taking in of the smoke of the Indian herb called Tobacco, by an instrument formed like a little ladell . . ." (quoted in Oswald 1961:55). At this time, pipe-makers organized themselves into guilds and produced relatively small numbers of distinctively marked pipes. But the industrial revolution forced those who would not mechanize out of business, and a relatively few manufacturers began producing large numbers of pipes (Humphrey 1969:14).

To make a pipe, a fine-grained plastic white clay, kaolin, was first worked with water into a thin paste and then seived to remove impurities. After the water evaporated, the clay was kneaded and a small glob was rolled into a cylindrical shape to form the stem. A second glob was attached to this cylinder to form the bowl. The clay was then allowed to dry further for a day or two, and when ready, placed in a hinged two piece mold - each half being one half of a pipe cut lengthwise. Before the mold was clamped shut, the bore was formed by inserting a long iron wire into the soft clay stem. The mold was then closed tightly. A lever was brought down which pressed an oiled stopper into the bowl of the pipe, forming the cavity. The bore wire was then pushed through the final few milimeters to join the cavity. At this point, the wire was removed, the pipe taken out of the mold, and excess clay scraped away with a knife. Finally, the pipes were carried to the kiln where "50 gross could be fired in from 8 to 12 hours. A boy and a workman could easily make five gross of pipes in a day's time" (Wilson 1961: 123).

The interior of the mold could be decorated in many ways, producing the variety of designs exhibited by clay pipes. The designs are most often in relief due to the ease in which the interior of the mold could be carved or stamped. It is somewhat more difficult to produce raised designs in the mold which cut into and incise the design on the pipe. And just as many molds were left undecorated, producing smooth, plain pipes whose only variations occur in the basic shape of the pipe and the mold line treatment. Mold line treatment varies as well on the decorated pipes. The mold line was most often scraped flat before firing. Occasionally, the mold line was flattened by cutting in a series of incised diagonal lines, and often the mold line was left unmodified. Many decorated pipes exhibit an additional method of mold line treatment: a row of leaves is displayed on either side of the unmodified mold line. The mold line is thus incorporated into the design as the stem out of which the leaves grow (Humphrey 1969:14).

Description of Clay Pipe Fragments
from 13WP25 and 13WP22

Catalogue # 435-25-2(1) This bowl fragment corresponds to the 26 specimens of Ribbed Type I from the Fort Atkinson, Iowa collection (Hotopp n.d.:25-26 and Fig. 5A). The ribs begin midway down the bowl and alternate in width from a thin raised line to a rib approximately 1/8 inch wide. The mold line has been flattened with incised diagonal lines. Ribbed Type I corresponds to Hanson's Ribbed Variety A pipes from Rome, New York. Hanson believes these pipes were manufactured in England (Hanson 1971:94).

Catalogue # 435-25-2(2) This bowl fragment is ribbed but the type cannot be determined. The fragment is thicker than most, approximately ½ inch. A narrow lip encircles the rim of the bowl.

Catalogue #435-25-3 This effigy bowl fragment is in the form of a human head. It is remarkably similar to a specimen from Fort Union, New Mexico, described by Wilson (1966:39 and Fig. 6D) as follows: "Made of red clay, the figure represented is a heavily bearded man with a head of long hair. His appearance suggests the biblical Sampson". The specimen from 13WP25 is made, however, of white clay. Furthermore, the lower portion of the face is missing, and although a moustache is present, it is impossible to know if the figure was bearded.

Catalogue # 435-25-4 This specimen is an undecorated stem fragment and is not diagnostic. The mold lines have been scraped before firing.

Catalogue #435-22-2 This stem fragment is of the type associated with the Ribbed Type I bowls (see above) from the Fort Atkinson collection. The ribs on the bowl terminate just beyond the spur in four parallel raised lines encircling the stem.

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Appendix C: Faunal Analysis of the McQuiston Historic House Site (13WP25), Wapello County, Iowa

Holmes A. Semken, Jr., Department of Geology
University of Iowa

Bone excavated from the McQuiston historic house site (13WP25),Wapello County, Iowa was divided into three categories for examination: (1) readily identificable material, (2) potentially identifiable material, and (3) unidentifiable material. Category one bone included two wild species (fox squirrel, Sciurus niger and cottontail rabbit, Sylvilagus sp.); five domestic animals (chicken, pig, sheep, cow, and horse); and a turkey humerus which may be either wild or domestic.

Twelve of the 20 identified individuals (Tables 19 and 20) were domestic and these represent over 99 percent of the available meat, irrespective of the horse (White, 1953). Evidence of butchering with a saw was clear in both the sheep and cow. No butcher marks were evident on the horse or pig. Both knife and saw marks were present in potentially identifiable remains. The pigs were killed (or died) while young. Only 2 of the 32 identified pig elements had distal fusion on the epiphyses and none were fused proximally. Judging from its complete skeletal count (Table 19) the horse either fell or was discarded into the well.

Category two material consisted of skeletal elements that can be identified to element, but not readily to species. Specific identifications were precluded either because of fragmental nature or insufficient comparative material in departmental collections. These elements included three scapula fragments, an ulna fragment, 12 rib fragments (5 with saw marks), eight cervical vertebrae (four sawed longitudinally and two with knife faceted articular surfaces), and four thoracic vertebrae (2 sizes).

Table 20 outlines the faunal distribution within the site. Each unit (basement floor, house fill, refuse pit, well, and surface deposits) contained at least four different species. Both the house fill and the well contained five species. While the counts are small, it appears that animal bone was randomally distributed throughout the site. Exact counts per provenience unit were not attempted because of small sample size. Also, the volume of matrix from which skeletal material was recovered was quite different for each unit (John Tandarich, personal communication).

Horse and sheep (Hildebrand, 1955) remains have been cataloged into the recent comparative collection, Department of Geology, University of Iowa in order to augment the domestic sample. All other bone has been returned to the Office of the State Archaeologist. It is recommended that all unidentifiable bone scraps and perhaps portions of the surface sample be discarded. Other remains should be saved for future analysis of trace elements.

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Table 19. Identified skeletal elements from the McQuiston Historic House Site (13WP25), Wapello County, Iowa

	Chicken	Turkey	Squirrel	Rabbit	Pig	Sheep	Cow	Horse	
Skull	-	-	-	-	-	-	-	1	
Mandible	-	-	1R	-	2L&2R	-	-	1L&1R	
Scapula	-	-	-	-	-	-	-	1L&1R	
Humerus	4L&5R	1R	1L	2R	2L&4R	-	-	1L&1R	
Ulna	1L&1R	-	1R	1L	3L	1L&1R(b)	1R	1L&1R	
Radius	1L&1R	-	1L	1L&1R	2L&3R	1L&1R	1R	1L&1R	
Innominate	0	0	-	-	1	-	1	1	
Femur	2L&1R	-	2L	2L&4R	3L&3R	-	-	1L&1R	
Tibia	0	0	-	5R&2L	3L&2R	1R	1R	1L&1R	
Calcaneum	0	0	-	-	1	-	1R		
Metapodial	0	0	-	2	1	1(b)	-	1L&LR	
Coracoid*	1	-	0	0	0	0	0	0	
Sternum*	1	-	0	0	0	0	0	0	
Carpometa-Carpus	1L	0	0	0	0	0	0	0	
Tibiotarsus*	2L&2R	-	0	0	0	0	0	0	
Tarsometa-*tarus	2L&2R	-	0	0	0	0	0	0	
Minimum Number Individual	5	1	2	5	4	1	1	1	20

Legend:

- Not identified

* Present only in birds

0 Not present in animal

b) Burned (cow): Ulna frag, distal tibia epiphysis, vertebra centrum and 14 fragments of bovid size

Table 20. Distribution of Faunal Elements in the McQuiston Historic House Site (13WP25), Wapello County, Iowa

	Basement Floor	House Fill	Refuse Pit	Well	Surface	Minimum Individual	Genus
Chicken	x	x	x	x	x	x	Gallus
Turkey	-	-	-	-	x	1	Meleagris
Squirrel	-	x	x	x	-	2	Sciurus
Rabbit	x	x	-	-	x	5	Sylvilagus
Pig	x	x	-	x	x	4	Sus
Sheep	-	-	x	-	-	1	Ovis
Cow	x	x	x(b)	x	-	1	Bos
Horse	-	-	-	x	-	1	Equus

Legend:

x: Recorded from unit

-: Not recorded from unit

(b): burned specimens present

Appendix D: The McQuistan Historic Site (13WP25) Gun Lock

Holmes A. Semken Jr., Dept. of Geology
Richard M. Schieken, Dept. of Pediatrics
University of Iowa

No marks remain on the McQuistan gun lock to identify its manufacturer, but it can be catagorized as a military rifle lock. It is too heavy for a commercial rifle or shotgun and smaller than a standard musket lock (Fig. 1A & B.) It is the size of a U.S. Model 1841 rifle lock and closely resembles a variety of European military models, comparing best with those of Prussian and Austrian origin.

The "lazy S" - shaped hammer and the short forend (distance dg, Fig. 1A) suggest that the lock originally was a flintlock and that it subsequently was converted to percussion ignition. The scarcity of flintlock arms today partially is a result of their having been modified to the more modern percussion system in the middle 1840's. Wholesale conversion of government arms was accomplished by removing the flashpan, frizzen, frizzen spring, and filling the touch hole. A percussion nipple to hold the cap and a single piece hammer was then installed. The mortise for the frizzen screw and frizzen spring screw (Fig. 1A) was filled by cutting their respective screws off flush with the lockplate. External evidence of the mortise for these screws is concealed by rust on the McQuistan lock. A radiograph (Fig. 1C) taken at 125KV clearly reveals the present of both the frizzen screw and frizzen spring screw mortise and confirms that the McQuistan specimen originally was a flintlock.

It is also clear from the radiograph that a new mainspring was inserted during or after conversion to percussion. Most flint weapons had a mainspring retaining screw (Fig. LA & C). These frequently were abandoned on percussion

Arms, the strength of a longer upper branch and the mainspring pivot being sufficient to hold the spring in place. The old mainspring screw mortise is visible on the McQuistan specimen (Fig. 1C). A broken mainspring rendered the lock useless. This break can be seen in Fig. 1C just below the diagonal white line. This malfunction is confirmed by the main spring being in the "cocked" position while the tumbler and sear are in the fixed position (Fig. 1C). Missing side plate lock screws indicate that the lock was separated from the gun prior to being discarded into the McQuistan well. Also, no other gun parts are associated in the collection of artifacts from the well.

The lock is preserved in the State Archaeological collections.

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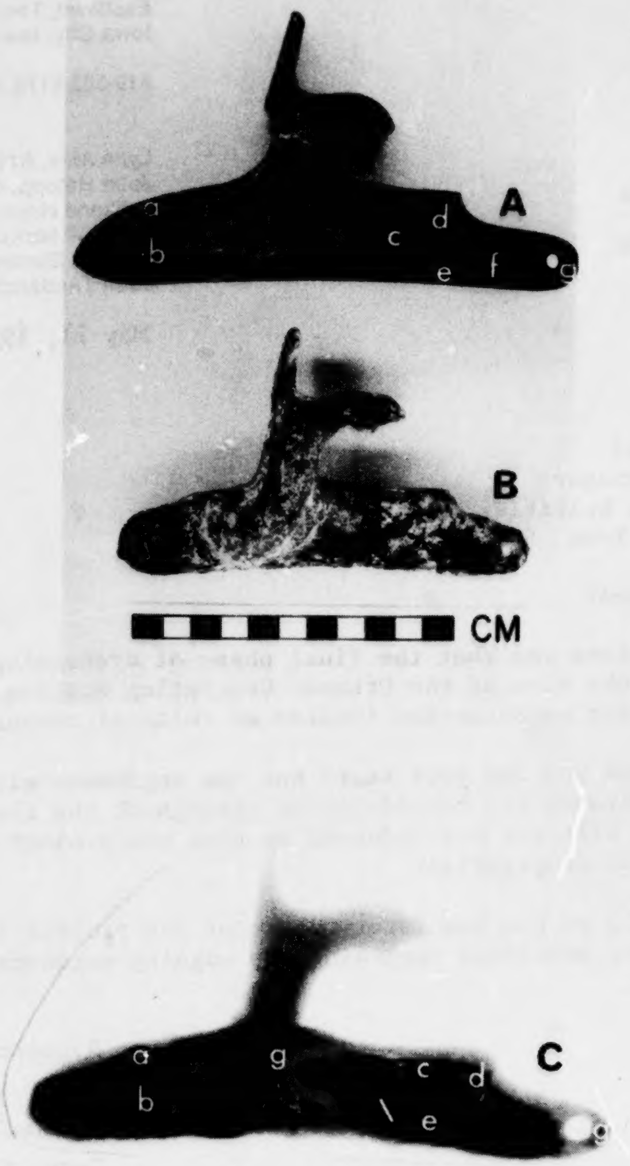

Figure 1. Gun locks converted from flint to percussion. A, Exterior view of U.S. Model 1816 musket lock, Nippes Contract; B, Exterior view of lock from McQuistan Historic Site (13WP25); C, Radiograph of the McQuistan lock. Nomenclature: a, sear spring screw; b, sear screw; c, mainspring retaining screw; d, frizzen screw; e, frizzen spring screw; f, mainspring pivot; g, lock plate side screws; line in radiograph--fracture position of McQuistan lock.

Office of the State Archaeologist

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Duane C. Anderson
Director and
State Archaeologist

May 11, 1976

Mr. Don McLeod
Production Manager
Iowa Southern Utilities Company
Centerville, Iowa 52544

Dear Mr. McLeod:

This is to inform you that the final phase of archaeological work has been completed at the site of the Ottumwa Generating Station. The entire area is now clear for construction insofar as cultural resources are concerned.

I wish to thank you and your staff and the engineers with Black and Veatch for your assistance and consideration throughout the field phase of the project. Mr. Slattery has informed me that the project was facilitated greatly by this cooperation.

Work will begin on the laboratory phase of the project in the near future. If you have any questions regarding the ongoing research, please feel free to contact me.

Sincerely,

Duane C Anderson

Duane C. Anderson
State Archaeologist

DCA:bh
cc:State Historic Preservation Officer
George Savage

STATE HISTORICAL DEPARTMENT OF IOWA
DIVISION OF HISTORIC PRESERVATION

ADRIAN D. ANDERSON, DIRECTOR
HISTORIC PRESERVATION OFFICER

June 29, 1976

RECEIVED
BLACK & VEATCH
JUL 2 1976
SYSTEMS ENG. DEPT.
LEGAL-ENV. GROUP

Mr. George R. Savage
Black & Veatch Engineering Co.
1500 Meadow Lake Parkway
Kansas City, Mo. 64114

Subject: Ottumwa Generating Station

Dear Mr. Savage:

This office has reviewed the investigation conducted at the site of the Ottumwa Generating Station. Cultural resources have been adequately considered and we find no reason to delay construction further.

Sincerely,

Adrian D. Anderson

Adrian D. Anderson
Historic Preservation Officer

ADA:EKA

B-13 MAC LEAN HALL . IOWA CITY, IOWA 52242
TELEPHONE 319.353.6949/319.353.4186

APPENDIX B

AQUATIC BIOLOGICAL DATA

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B-2	Phytoplankton - Station 2 - Upper Des Moines River
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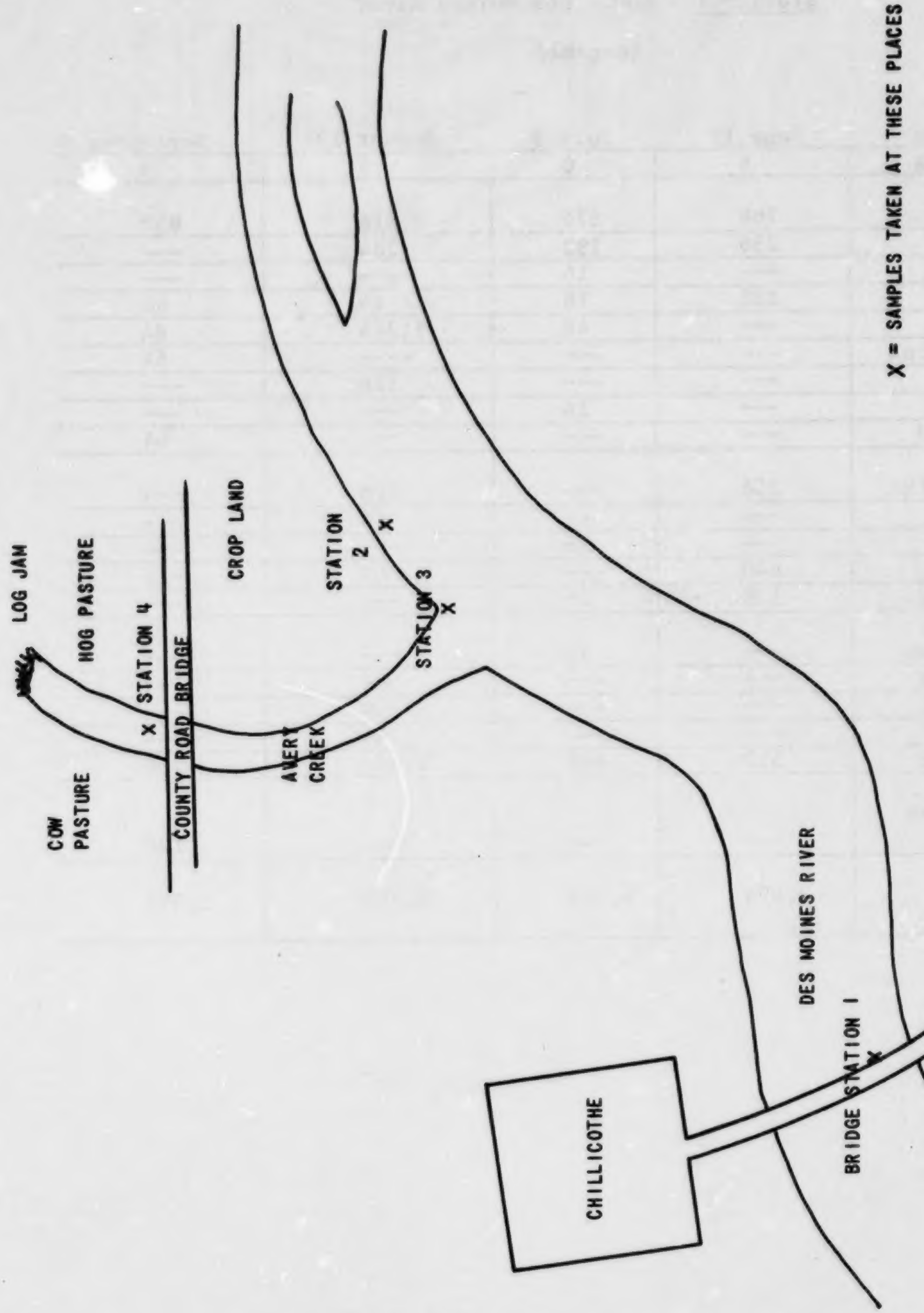
B-4	Phytoplankton - Station 4 - Upper Avery Creek
B-5	Zooplankton Analysis - Des Moines River & Avery Creek
B-6	Periphyton Analysis - Des Moines River & Avery Creek

Figure No.

B-1	Sampling Points

FIGURE B-1



SAMPLING POINTS

Table B-1

Phytoplankton

Station 1 - Lower Des Moines River

(org/ml)

Species	June 17	July 8	August 13	September 9
Oscillatoria	6	0	6	13
Cyclotella	768	576	2,816	832
Melosira	256	192	384	---
Meridion	---	16	---	---
Navicula	128	16	64	64
Nitzschia	---	48	1,344	64
Stephanodiscus	---	---	---	64
Surirella	---	---	128	---
Synedra	---	16	---	---
Unidentified	---	---	---	64
Chlorella-like	256	---	128	---
Chroococcus	---	---	64	---
Coelastrum	---	16	---	---
Scenedesmus	640	---	64	---
Unidentified	128	16	---	---
Chlamydamonas	---	32	---	---
Chrysococcus	---	---	64	---
Euglena	---	---	64	---
Pandorina	---	---	64	---
Unidentified	512	448	1,600	768
Miscellaneous Ciliate	---	---	---	128
Total	2,694	1,376	6,790	1,997

Table B-2

Phytoplankton

Station 2 - Upper Des Moines River

(org/ml)

Species	June 17	July 8	August 13	September 9
Anabaena	-	-	-	6
Anacystis	-	-	-	6
Oscillatoria	-	-	13	38
Cyclotella	1664	496	3904	736
Melosira	-	304	448	-
Navicula	64	-	-	-
Nitzschia	448	16	1280	-
Unidentified	-	16	-	32
Actinastrum	64	-	-	-
Chlorella-like	-	-	64	-
Chroococcus	64	-	384	-
Coelastrum	-	16	64	-
Oocystis	64	-	-	-
Scenedesmus	256	16	128	32
Unidentified	64	-	-	32
Chlamydomonas	64	16	-	-
Chrysococcus	-	-	192	32
Euglena	64	-	-	32
Pandorina	-	-	-	64
Trachelomonas	-	-	64	-
Unidentified	1280	576	1408	992
Miscellaneous Ciliate	-	48	-	32
Total	4096	1504	7949	2034

Table B-3

Phytoplankton

Station 3 - Lower Avery Creek

(org/ml)

Species	June 17	July 8	August 13	September 9
Oscillatoria	-	-	-	6
Phormidium	-	-	6	-
Cyclotella	1920	384	960	992
Cymbella	-	-	64	-
Gyrosigma	-	-	128	-
Melosira	-	240	128	192
Meridion	-	16	64	-
Nitzschia	-	-	1088	96
Surirella	-	-	-	32
Synedra	-	16	-	-
Unidentified	-	-	128	32
Chlorella-like	-	-	192	-
Chroococcus	-	16	64	-
Coelastrum	128	32	-	-
Scenedesmus	192	48	-	64
Unidentified	64	32	-	-
Chlamydomonas	192	-	-	-
Chrysococcus	64	-	-	-
Euglena	256	-	256	-
Pandorina	-	-	64	-
Trachelomonas	64	-	-	32
Unidentified	1600	512	1408	992
Miscellaneous				
Ciliate	192	-	-	96
Codonella	-	-	128	-
Unidentified	64	16	-	-
Total	4736	1312	4678	2,534

Table B-4

Phytoplankton

Station 4 - Upper Avery Creek

(org/ml)

Species	June 17	July 8	August 13	September 9
Anacystis	-	-	6	-
Oscillatoria	-	-	6	-
Cyclotella	704	2394	1344	1376
Cymbella	-	-	64	-
Melosira	-	-	-	288
Navicula	-	-	128	-
Nitzschia	96	80	896	64
Unidentified	-	16	-	-
Ankistrodesmus	-	80	-	-
Chlorella-like	-	64	-	-
Chroococcus	-	16	-	32
Coelastrum	-	16	64	-
Oocystis	-	16	-	-
Scenedesmus	96	64	-	96
Tetraedron	-	-	64	-
Unidentified	96	80	-	32
Chlamydomonas	64	-	2112	64
Chrysococcus	-	48	896	32
Euglena	1152	432	1856	1696
Lepocinclis	-	16	-	32
Pandorina	-	16	192	-
Phacus	64	16	-	32
Peridinium	-	-	192	-
Trachelomonas	32	256	-	32
Unidentified	1372	912	2368	2080
Miscellaneous				
Ciliate	256	-	-	32
Codonella	-	-	-	32
Rotifer	-	16	-	-
Unidentified	-	32	-	-
Total	3936	4570	10188	5920

Table B-5

Zooplankton Analysis

Des Moines River and Avery Creek

	Station 1	Station 2	Station 3	Station 4
June 21*				
Cladocerans	16%	17%	4%	9%
Copepods	73%	80%	96%	82%
Rotifers	11%	3%	---	9%
July 17				
Cladocerans	3 org/1	3 org/1	3 org/1	1 org/1
Copepods	3 org/1	3 org/1	4 org/1	3 org/1
Rotifers	few present	few present	few present	few present
Sept. 27				
Cladocerans	2 org/100 1	6 org/100 1	-----------	-----------
Copepods	1 org/100 1	3 org/100 1	NA	NA
Rotifers	few present	few present	-----------	-----------

*Relative Abundance

Periphyton Analysis
June - July 1975

Species	Station 2	Station 3	Station 4
Actinastrum			x
Amoeba	x		
Anabaena	x		
Chlamydamonas			x
Chilodonella			x
Cladoceran			x
Closterium	x		x
Coelastrum	x		
Coleps	x		
Cosmarium	x	x	
Cymbella	x		x
Dictyosphaerium		x	
Euglena	x		
Frontania	x	x	
Gloecystis	x		
Gonphonema			x
Gyrosigma			x
Melosira	x	x	x
Microcystis	x	x	x
Microspora	x	x	x
Monas	x		
Navicula	x	x	x
Nostoc	x	x	x
Oocystis		x	x
Paramecuem	x		x
Phacus	x	x	x
Rotifer	x		x
Scenedesmus	x	x	x
Synedra	x		
Tribonema		x	
Ulothrix	x	x	x
Vorticulla	x	x	x
Ash free weight (gms/area slide)	0.024	0.020	0.034

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Table B-7

Water Quality Parameters
June 17, 1975

	Sta. 1 Lower Des Moines R.	Sta. 2 Upper Des Moines R.	Sta. 3 Lower Avery Creek	Sta. 4 Upper Avery Creek
pH	7.7	8.1	7.9	7.7
DO (mg/1)	7.7	7.9	7.7	9.0
Tot. Alk. (mg $CaCO_3$/1)	203	203	167	131
NO_3 (mg N/1)	7.5	6.9	4.5	0.4
NH_3 (mg N/1)	<0.04	0.04	<0.04	0.04
TOC (mg C/1)	7	9	9	11
Calcium (mg $CaCO_3$/1)	212	208	200	212
Orthophosphate (mg P/1)	0.21	0.15	0.08	0.02
Tot. Phosphate (mg P/1)	0.25	0.18	0.12	0.11
Sodium (mg Na/1)	8	9	13	20
Potassium (mg K/1)	2.3	1.8	3.2	6.0
Magnesium (mg Md/1)	25	25	24	18
Chloride (mg Cl^-/1)	18	17	15	9
Sulfate (mg SO_4^{-2}/1)	52	52	82	168
Silica (mg SiO_2/1)	9.1	9.2	7.8	4.3
Temperature °C	23.0	20.0	23.0	23.0
Total Dissolved Solids	460	460	550	470
Secchi Disc (meters)	0.50	0.25	0.25	0.25
Turbidity (JTU)	26	30	17	16
Specific Conductance	NA	NA	NA	NA
BOD_5 (mg/1)	1.6	1.5	2.5	5.3
Total Coliforms (org/100 ml)	800	300	900	4100
Fecal Coliforms (org/100 ml)	240	10	470	1900

Table B-8

Water Quality Parameters
July 8, 1975

	Sta. 1 Lower Des Moines R.	Sta. 2 Upper Des Moines R.	Sta. 3 Lower Avery Creek	Sta. 4 Upper Avery Creek
pH	7.9	7.9	7.9	7.8
DO (mg/l)	7.5	7.3	7.1	8.6
Tot. Alk. (mg $CaCO_3$/l)	195	195	194	167
NO_3 (mg N/l)	7.8	7.6	7.0	0.6
NH_3 (mg N/l)	0.04	0.06	<0.04	0.06
TOC (mg C/l)	9	5	7	16
Calcium (mg $CaCO_3$/l)	192	204	192	252
Orthophosphate (mg P/l)	0.11	0.12	0.11	0.01
Tot. Phosphate (mg P/l)	0.18	0.14	0.15	0.09
Sodium (mg Na/l)	7.5	8.0	9.2	2.0
Potassium (mg K/l)	2.7	2.7	2.9	7.8
Magnesium (mg Md/l)	22	22	23	22
Chloride (mg Cl^-/l)	16.0	17.0	17.0	11.0
Sulfate (mg SO_4^{-2}/l)	47	59	67	114
Silica (mg SiO_2/l)	7.5	7.9	9.5	1.2
Temperature °C	28.2	27.8	28.0	28.0
Total Dissolved Solids	430	410	380	540
Secchi Disc (meters)	0.25	0.25	0.30	0.25
Turbidity (JTU)	18	20	21	12
Specific Conductance	590	700	590	590
BOD_5 (mg/l)	3.8	3.4	3.1	8.2
Total Coliforms (org/100 ml)	200	400	600	1600
Fecal Coliforms (org/100 ml)	50	100	280	800

Table B-9

Water Quality Parameters
August 13, 1975

	Sta. 1 Lower Des Moines R.	Sta. 2 Upper Des Moines R.	Sta. 3 Lower Avery Creek	Sta. 4 Upper Avery Creek
pH	8.0	7.9	7.8	7.1
DO (mg/l)	6.6	6.6	5.3	8.0
Tot. Alk. (mg $CaCO_3$/l)	198	194	198	254
NO_3 (mg N/l)	0.85	0.82	0.80	0.05
NH_3 (mg N/l)	0.06	0.08	0.06	0.20
TOC (mg C/l)	11	11	9	23
Calcium (mg $CaCO_3$/l)	244	208	192	334
Orthophosphate (mg P/l)	0.12	0.14	0.35	0.16
Tot. Phosphate (mg P/l)	0.39	0.40	0.83	0.73
Sodium (mg Na/l)	NA	NA	NA	NA
Potassium (mg K/l)	NA	NA	NA	NA
Magnesium (mg Md/l)	17.4	22.3	24.3	25.7
Chloride (mg Cl^-/l)	24.0	24.0	23.0	9.5
Sulfate (mg SO_4^{-2}/l)	116	116	118	112
Silica (mg SiO_2/l)	4.9	4.9	4.8	3.4
Temperature °C	25.8	25.9	25.9	24.5
Total Dissolved Solids	450	420	430	560
Secchi Disc (meters)	NA	0.25	0.25	0.25
Turbidity (JTU)	15	18	16	18
Specific Conductance	590	578	590	788
BOD_5 (mg/l)	1.5	0.8	1.7	7.3
Total Coliforms (org/100 ml)	2000	3700	4300	3500
Fecal Coliforms (org/100 ml)	320	1300	2500	1300

Table B-10

Water Quality Parameters
September 9, 1975

	Sta. 1 Lower Des Moines R.	Sta. 2 Upper Des Moines R.	Sta. 3 Lower Avery Creek	Sta. 4 Upper Avery Creek
pH	8.1	8.0	8.0	6.8
DO (mg/l)	6.8	5.1	7.9	4.9
Tot. Alk. (mg $CaCO_3$/l)	142	144	139	68
NO_3 (mg N/l)	1.55	1.55	1.50	0.55
NH_3 (mg N/l)	0.02	0.01	0.04	0.50
TOC (mg C/l)	12	11	12	21
Calcium (mg $CaCO_3$/l)	160	144	144	236
Orthophosphate (mg P/l)	0.12	0.14	0.13	0.01
Tot. Phosphate (mg P/l)	0.16	0.21	0.18	0.13
Sodium (mg Na/l)	14	17	16	12
Potassium (mg K/l)	4.8	5.0	5.4	8.6
Magnesium (mg Md/l)	52	64	64	56
Chloride (mg Cl^-/l)	17.0	16.5	15.5	5.0
Sulfate (mg SO_4^{-2}/l)	68	85	80	220
Silica (mg SiO_2/l)	3.9	4.2	4.2	3.2
Temperature °C	22.6	21.8	21.8	21.0
Total Dissolved Solids	150	150	230	240
Secchi Disc (meters)	NA	NA	NA	NA
Turbidity (JTU)	39	42	40	34
Specific Conductance	407	395	407	577
BOD_5 (mg/l)	1.0	1.3	1.5	3.5
Total Coliforms (org/100 ml)	800	400	700	1700
Fecal Coliforms (org/100 ml)	560	340	800	1500

Table B-11

Pesticides

Des Moines River and Avery Creek
(Parts per trillion)

Station & Date	Heptachlor Epoxide	Heptachlor	Dieldrin	Aldrin
Station 1				
June 17	-	-	13.0	-
July 8	6.3	-	17.0	-
Aug. 13	-	-	8.0	-
Sept. 9	-	trace	11.0	-
Station 2				
June 17	-	-	13.0	-
July 8	6.9	-	18.0	-
Aug. 13	-	-	8.0	-
Sept. 9	-	-	7.0	-
Station 3				
June 17	-	5.5	13.0	-
July 8	-	-	16.0	-
Aug. 13	2.0	-	8.0	-
Sept. 9	-	-	10.0	-
Station 4				
June 17	-	4.9	11.0	-
July 8	-	-	13.0	-
Aug. 13	-	-	6.0	-
Sept. 9	7.0	-	8.0	trace

Table B-12

Metals (µg/1)
(Total metals in water)

Des Moines River and Avery Creek

Station and Date	Cd	Cn^{+6}	Cu	Fe*	Pb	Zn	Hg (ppb)
Station 1 (Lower Des Moines River Station near Chillicothe)							
June 17	<10	50	33	1.1	33	<10	NA
July 8	<10	35	<10	.65	<10	<10	0.25 ppb
Aug. 13	<10	<10	70	.48	44	15	0.40
Sept. 9	<10	<10	67	.25	19	15	NA
Station 2 (Upper Des Moines River Station Above Avery Creek)							
June 17	<10	41	30	.95	47	<10	NA
July 8	<10	49	<10	.65	<10	10	0.25 ppb
Aug. 13	<10	<10	17	.48	16	17	0.38
Sept. 9	<10	<10	12	.79	17	15	NA
Station 3 (Lower Avery Creek Station at Confluence with Des Moines River)							
June 17	<10	62	30	.77	52	<10	NA
July 8	<10	32	130	.77	<10	11	0.25 ppb
Aug. 13	<10	<10	10	.79	24	12	0.40
Sept. 9	<10	<10	12	.79	42	14	NA
Station 4 (Upper Avery Creek Station Near County Road Bridge)							
June 17	<10	50	33	.77	45	<10	NA
July 8	<10	40	<10	.65	<10	<10	0.25 ppb
Aug. 13	<10	<10	16	1.50	25	17	0.43
Sept. 9	<10	<10	12	1.85	36	12	NA

*mg/1

Table B-13

Macroinvertebrates

Des Moines River near Eddyville (Highway 137)

Organisms/meter^2

Organisms	July 2	August 1	August 30	September 26	October 24
Ephemeroptera					
Baetis sp.	155	2,153	1,021	49	100
Stenonema	22	---	127	250	1,909
Caenis	22	---	---	---	---
Isonychia	622	543	222	---	---
Diptera					
Simulidae	2,688	22	38	27	---
Empididae	200	27	11	---	---
Chironomidae	377	155	793	1,087	821
Trichoptera					
Hydropsyche sp.	2,397	3,633	1,887	815	1,370
Potamyia	21,511	3,146	3,596	9,351	1,276
Hydroptilidae	---	194	94	5	66
Cheumatopsyche	421	38	11	27	---
Leptocella	---	11	---	---	---
Psychomyiidae	---	---	11	22	5
Miscellaneous					
Coleoptera	---	5	---	---	---
Plecoptera	---	---	---	---	105
Odonata	---	---	---	---	---
Annelida	---	---	---	---	---
Acarina	---	5	---	---	5
Total	28,415	9,932	7,811	11,633	5,657

Source: Dr. W. B. Merkley, Drake University, 1975.

Table B-14

Macroinvertebrates

Des Moines River at Chillicothe Bridge

Organisms/meter^2

Organisms	July 2	August 1	August 30	September 26	October 24
Ephemeroptera					
Baetis sp.	66	44	138	16	---
Stenonema	5	---	33	16	1,276
Caenis	11	---	---	16	---
Isonychia	155	50	88	49	111
Diptera					
Simulidae	260	5	11	5	---
Empididae	---	---	---	16	---
Chironomidae	327	50	155	122	1,115
Trichoptera					
Hydropsyche sp.	2,958	2,824	2,059	649	593
Potamyia	11,888	1,942	2,713	5,555	1,687
Hydroptilidae	5	22	5	---	---
Chematopsyche	38	---	11	22	27
Leptocella	---	---	---	22	---
Psychomyiidae	---	---	22	38	77
Miscellaneous					
Coleoptera	---	---	---	---	---
Plecoptera	---	---	---	---	138
Odonata	---	---	---	---	---
Annelida	---	---	---	---	---
Acarina	---	---	---	---	---
Total	15,713	4,937	5,235	6,526	5,024

Source: Dr. W. B. Merkley, Drake University, 1975.

Table B-15

Macroinvertebrates

Avery Creek Near County Road Bridge

Organisms/meter^2

Organisms	July 2	August 1	August 30	September 26	October 24
Ephemeroptera					
Baetis sp.	---	5	27	---	---
Stenonema	38	---	---	---	5
Caenis	27	---	---	---	---
Isonychia	---	---	---	---	---
Diptera					
Simulidae	55	---	---	---	---
Empididae	---	---	---	---	---
Chironomidae	782	27,217	20,712	14,446	4,512
Trichoptera					
Hydropsyche sp.	5	22	11	---	---
Potamyia	44	172	133	22	5
Hydroptilidae	---	---	---	---	---
Cheumatopsyche	5	---	---	---	---
Leptocella	---	---	---	---	---
Psychomyiidae	---	---	---	---	---
Miscellaneous					
Coleoptera	---	5	---	---	---
Plecoptera	---	---	---	---	---
Odonata	---	---	11	11	5
Annelida	---	155	---	---	---
Acarina	---	---	---	---	---
Total	956	27,576	20,894	14,479	4,527

Source: Dr. W. B. Merkley, Drake University, 1975.

Table B-16

Macroinvertebrates

Pond Samples within Project Site

Organisms/meter^2

Organisms	July 2	August 1	August 30	September 26	October 24
Ephemeroptera					
Caenis	2	---	---	---	---
Hexagenia	21	78	26	2	---
Diptera					
Chironomidae	271	209	144	450	78
Coleoptera					
Gyrinidae	---	2	1	1	---
Haliplidae	1	5	1	---	---
Odonata					
Anisoptera	9	4	11	27	17
Zygoptera	2	23	4	22	51
Annelida					
Lumbricidae	4	3	2	4	3
Hemiptera					
Notonectidae	2	---	3	---	---
Corixidae	6	11	13	2	---
Ranatra	---	2	2	4	---
Amphipoda					
Hyallela	3	7	16	5	105
Mollusca					
Physa	16	23	12	14	58
Total	337	367	235	531	312

Source: Dr. W. B. Merkley, Drake University, 1975.

Table B-17

Macroinvertebrates

Organisms in drift at Eddyville (Highway 137)

Numbers/hour per 15.5 ft^3/sec.*

Organisms	July 2	August 1	August 30	September 26	October 24
Ephemeroptera					
Baetis sp.	6	---	---	14	---
Stenonema	20	20	6	14	2
Caenis	---	2	10	---	---
Isonychia	---	8	6	---	2
Diptera					
Simulidae	3	---	---	---	2
Empididae	---	5	---	14	2
Chironomidae	30	215	97	113	9
Trichoptera					
Hydropsyche sp.	200	442	1,065	155	45
Potamyia	23	32	26	98	7
Hydroptilidae	---	---	---	---	---
Cheumatopsyche	---	55	136	---	7
Leptocella	---	---	---	---	---
Psychomyiidae	---	---	---	---	---
Miscellaneous					
Coleoptera	---	7	10	---	---
Plecoptera	---	---	---	---	---
Odonata	---	---	---	---	---
Annelida	---	---	---	---	---
Acarina	---	---	---	---	---
Total	282	786	1,356	408	76

* 15.5 ft^3/sec. is maximum volume of make-up water required for proposed project.

Source: Dr. W. B. Merkley, Drake University, 1975.

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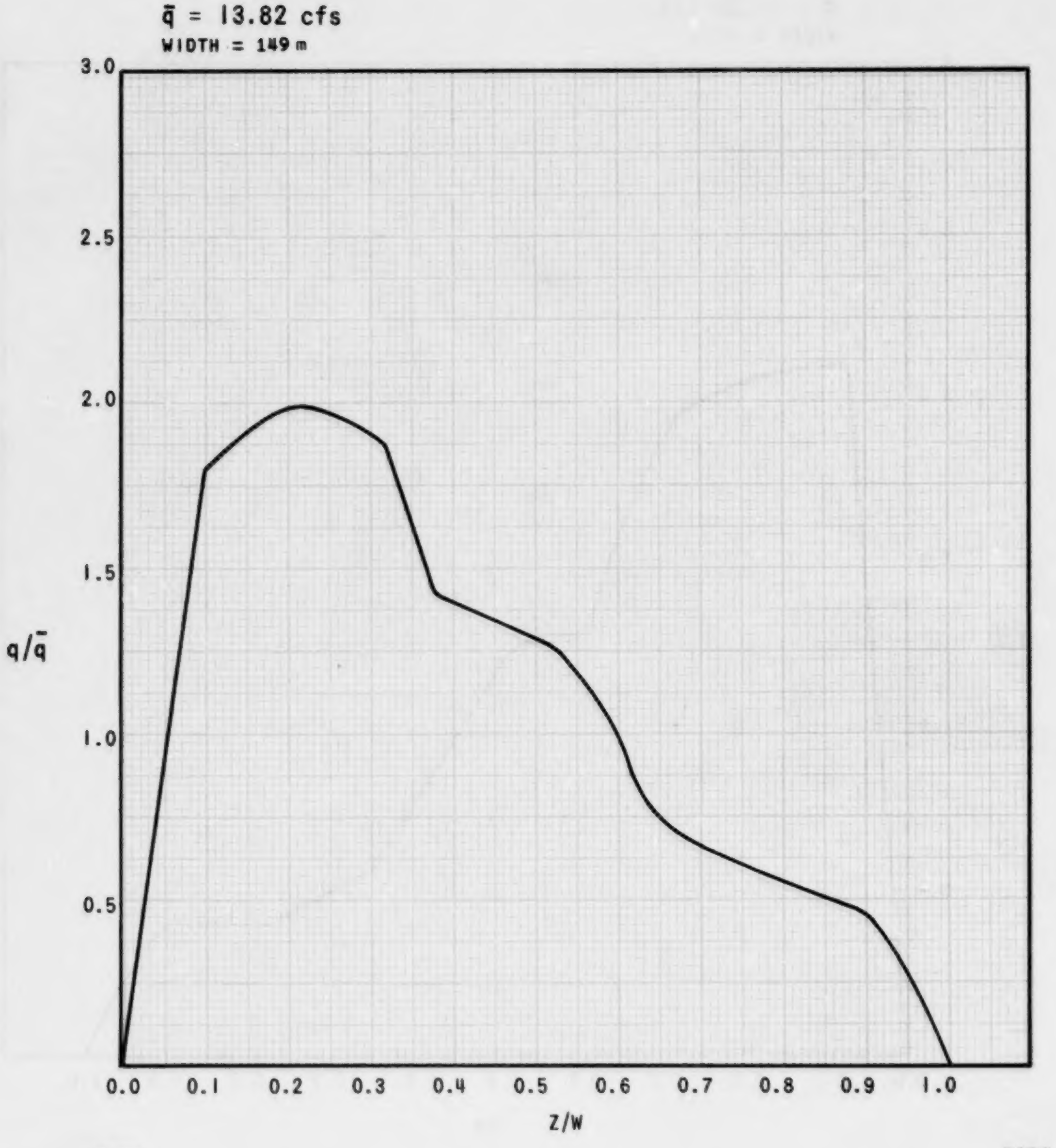
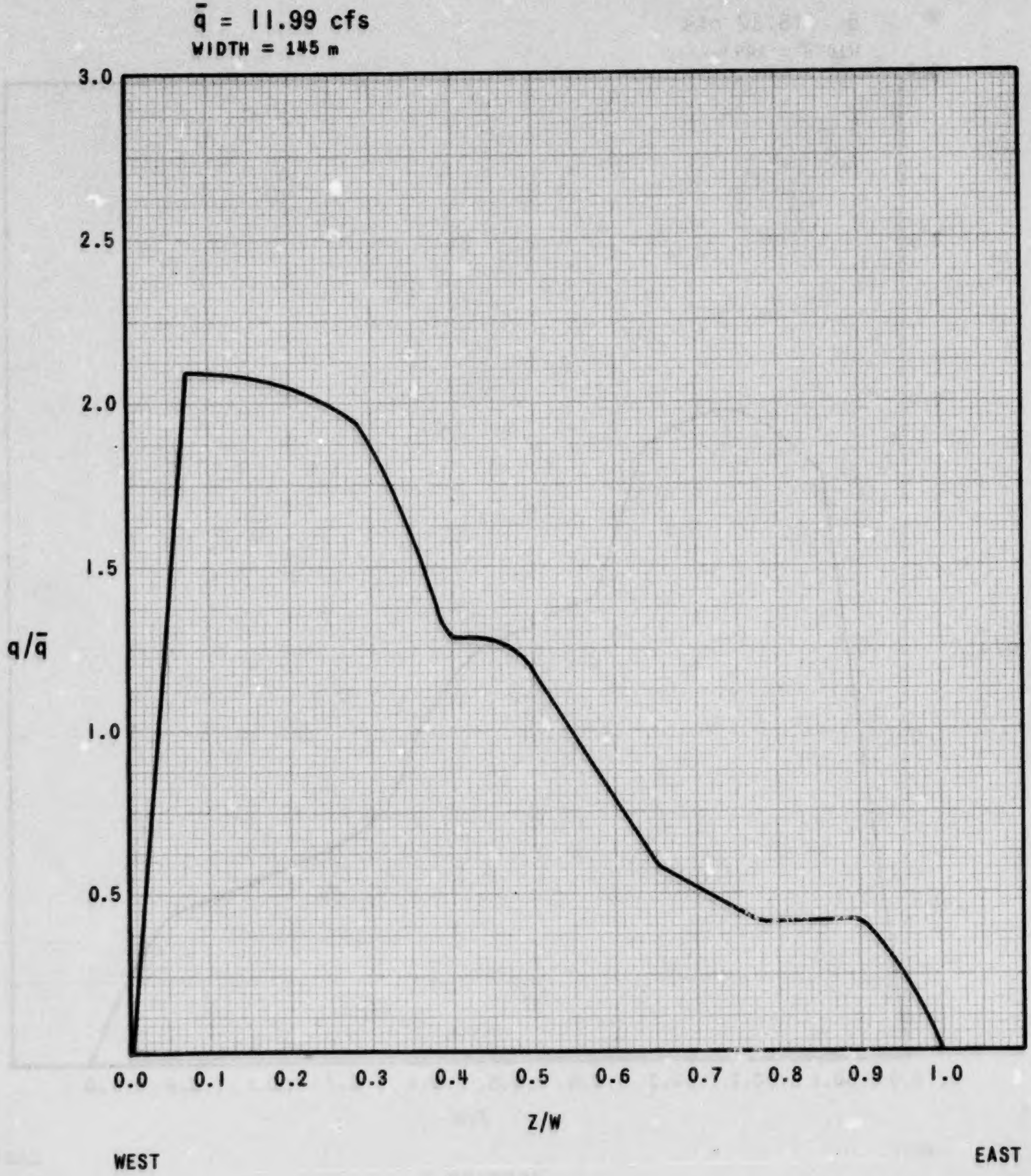


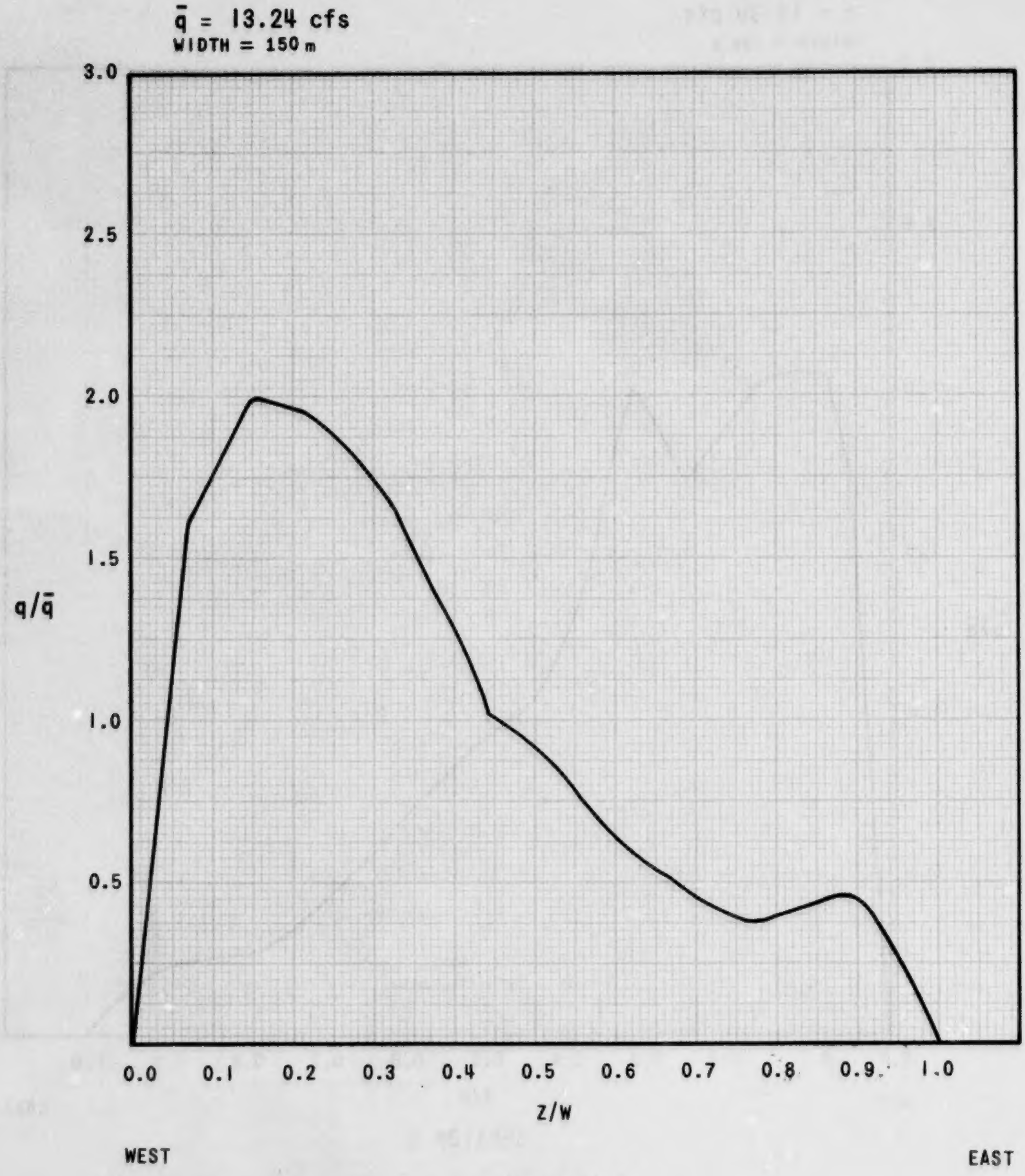
SECTION I

CURRENT PROFILE--DES MOINES RIVER



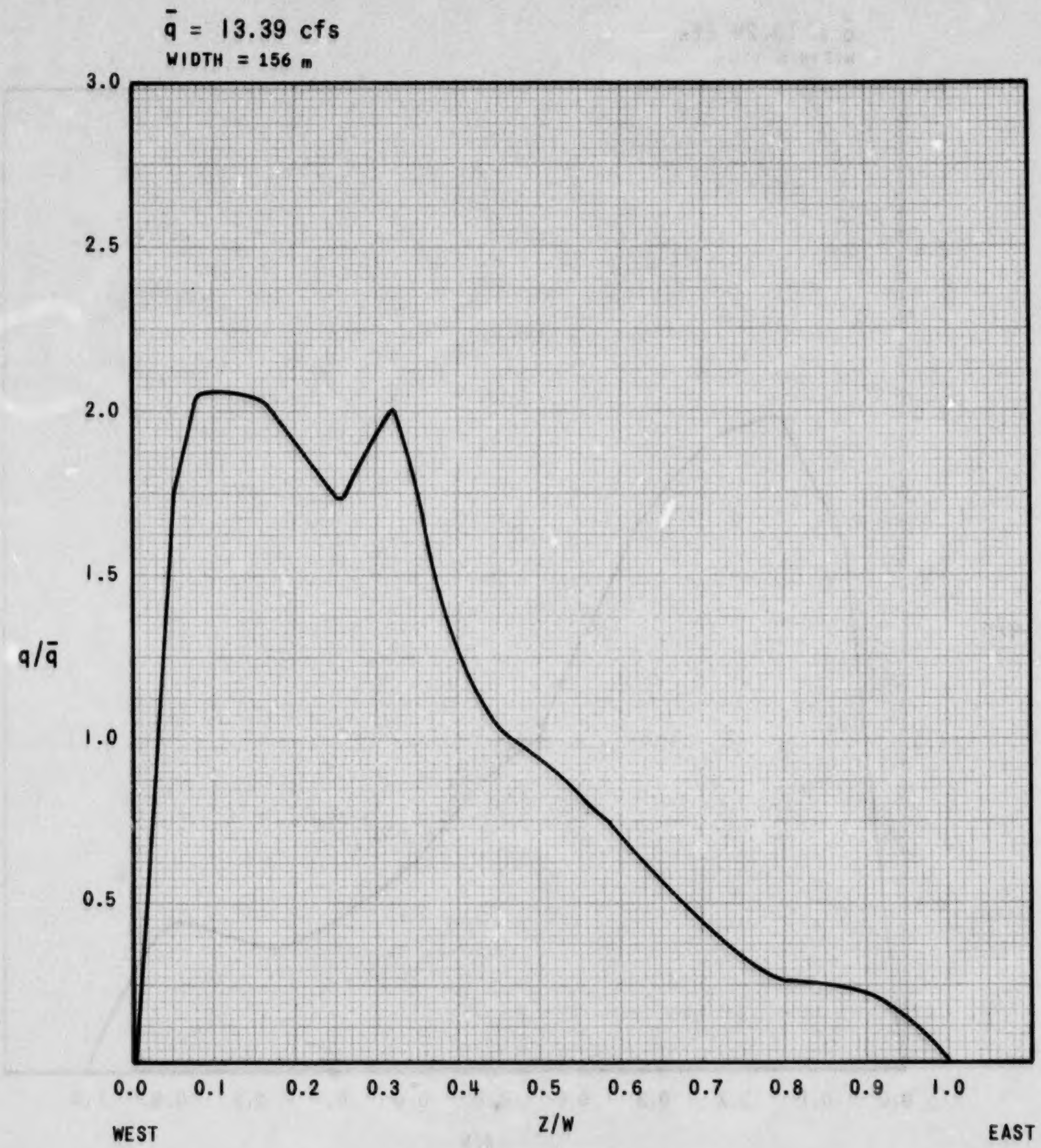
SECTION 3

CURRENT PROFILE--DES MOINES RIVER



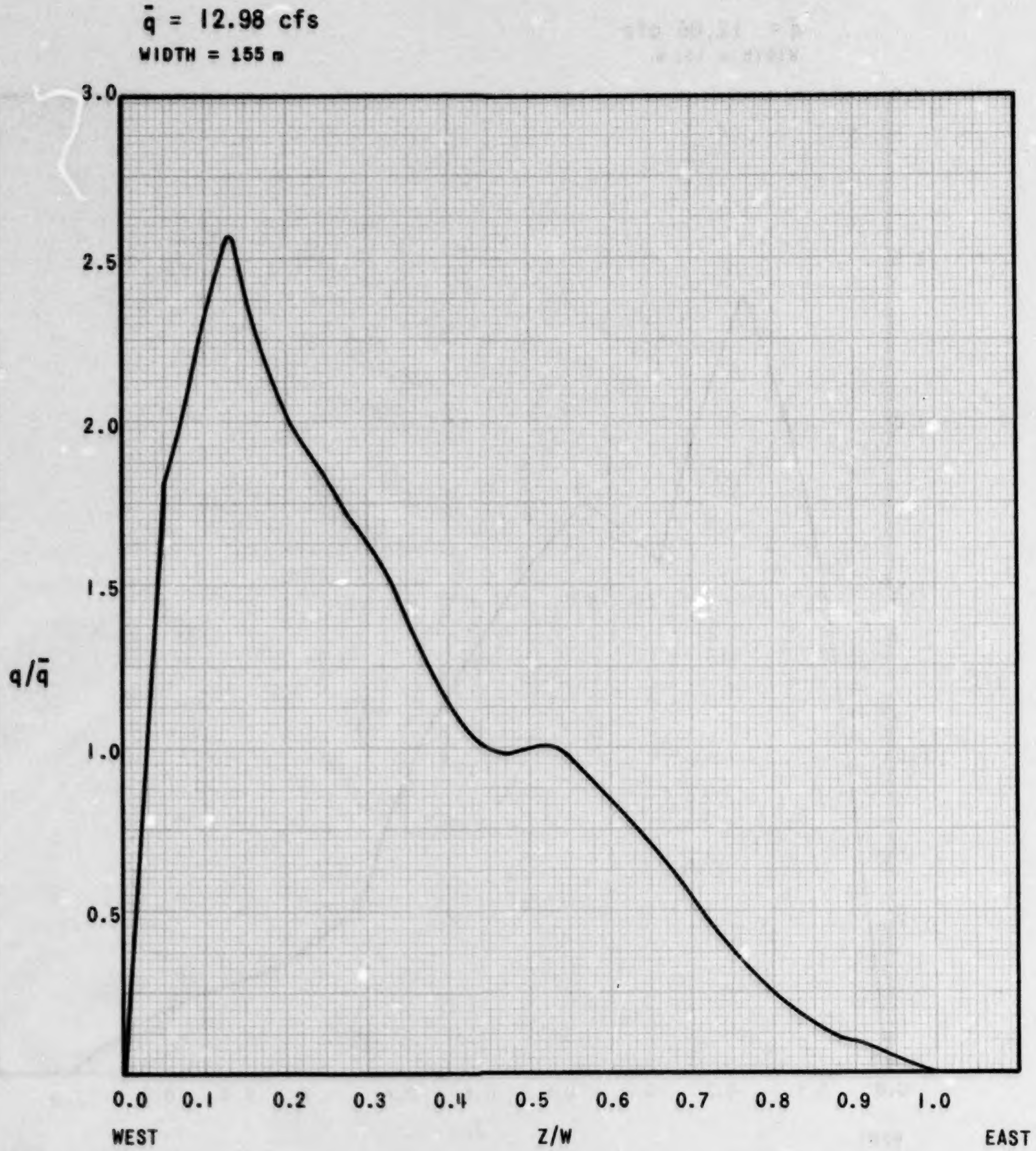
SECTION 2

CURRENT PROFILE--DES MOINES RIVER



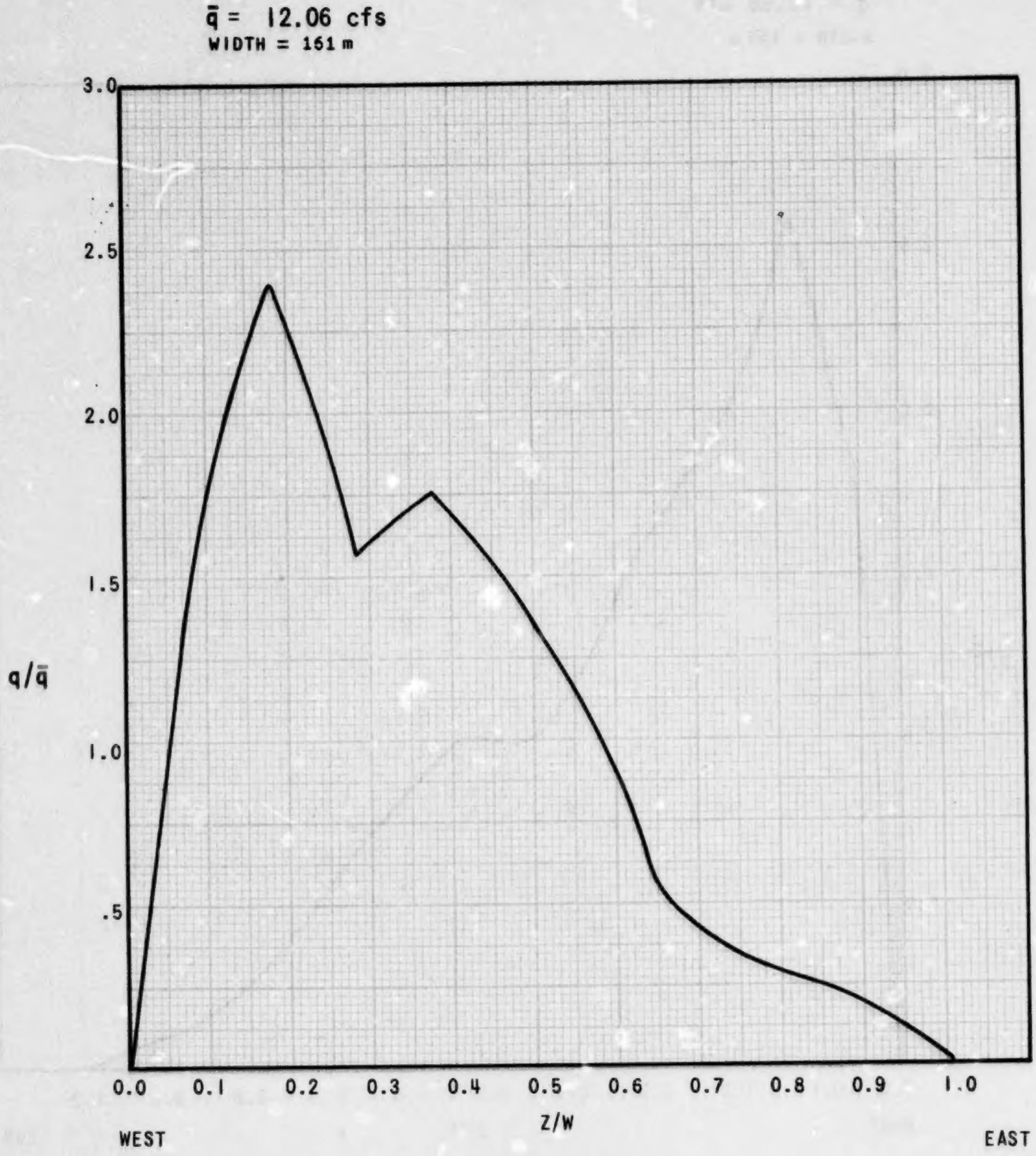
SECTION 4

CURRENT PROFILE--DES MOINES RIVER



SECTION 5

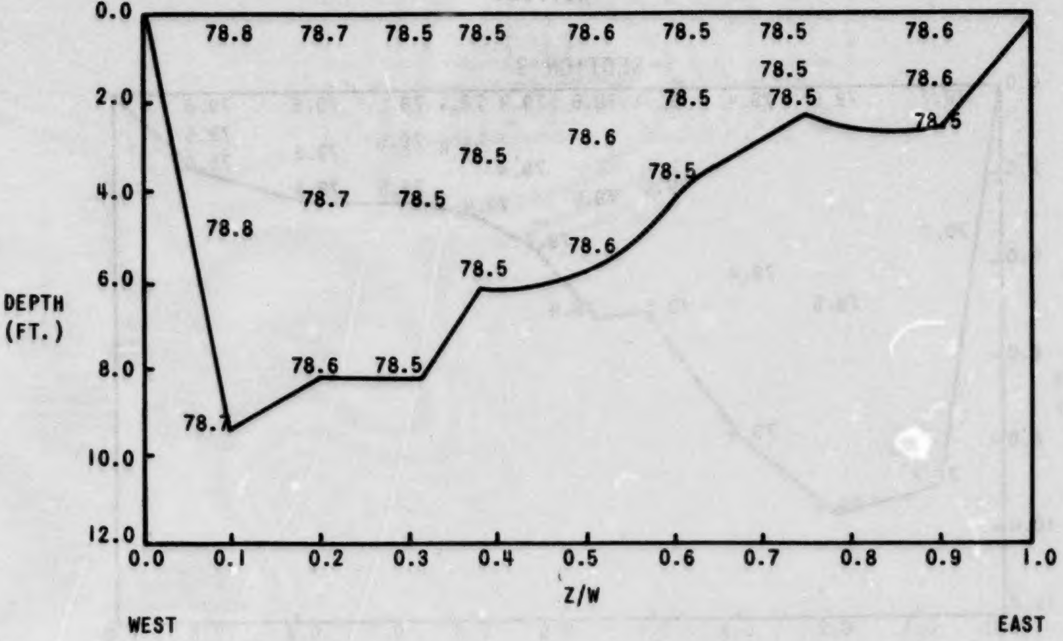
CURRENT PROFILE--DES MOINES RIVER



SECTION 6

CURRENT PROFILE--DES MOINES RIVER

SECTION 1



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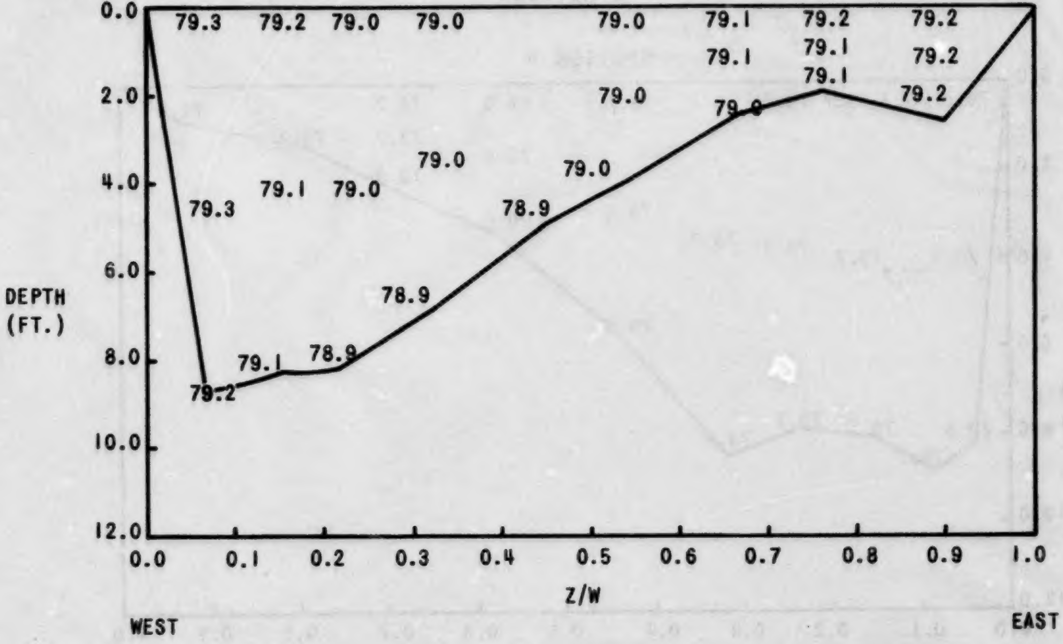
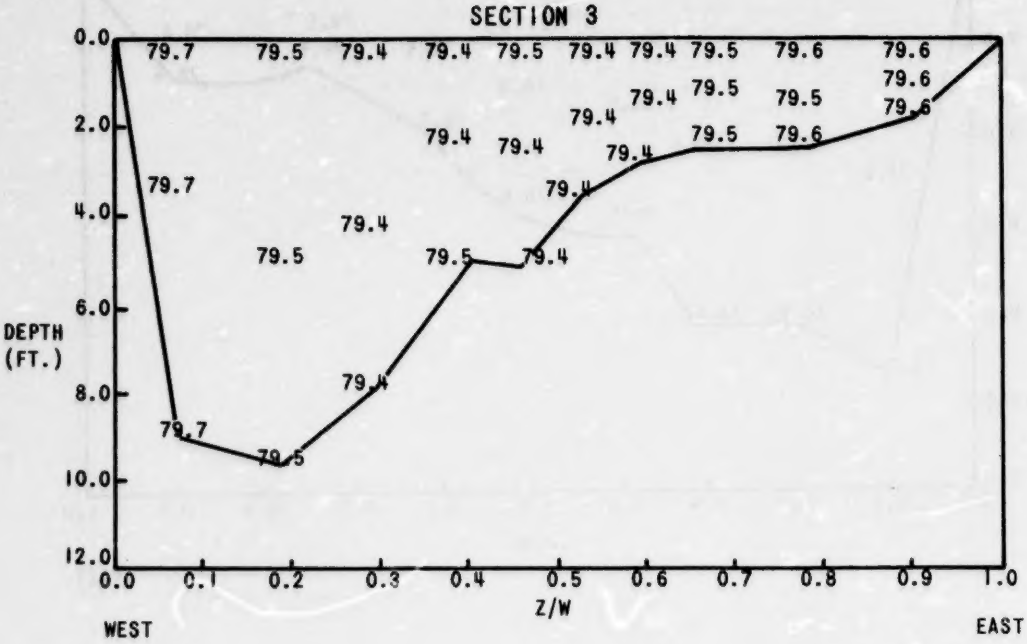
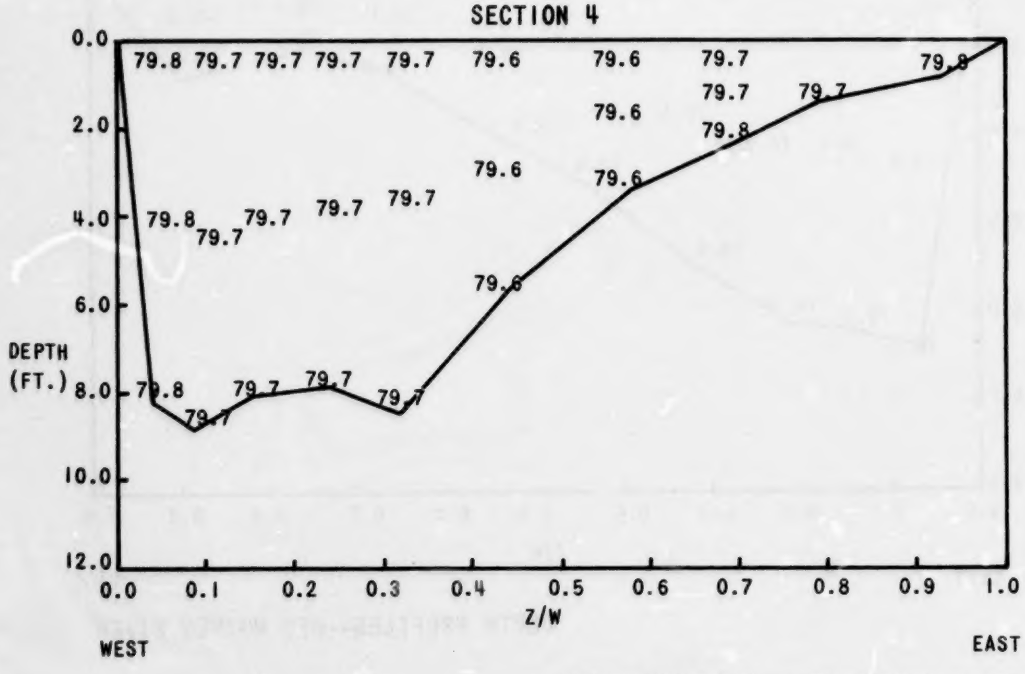
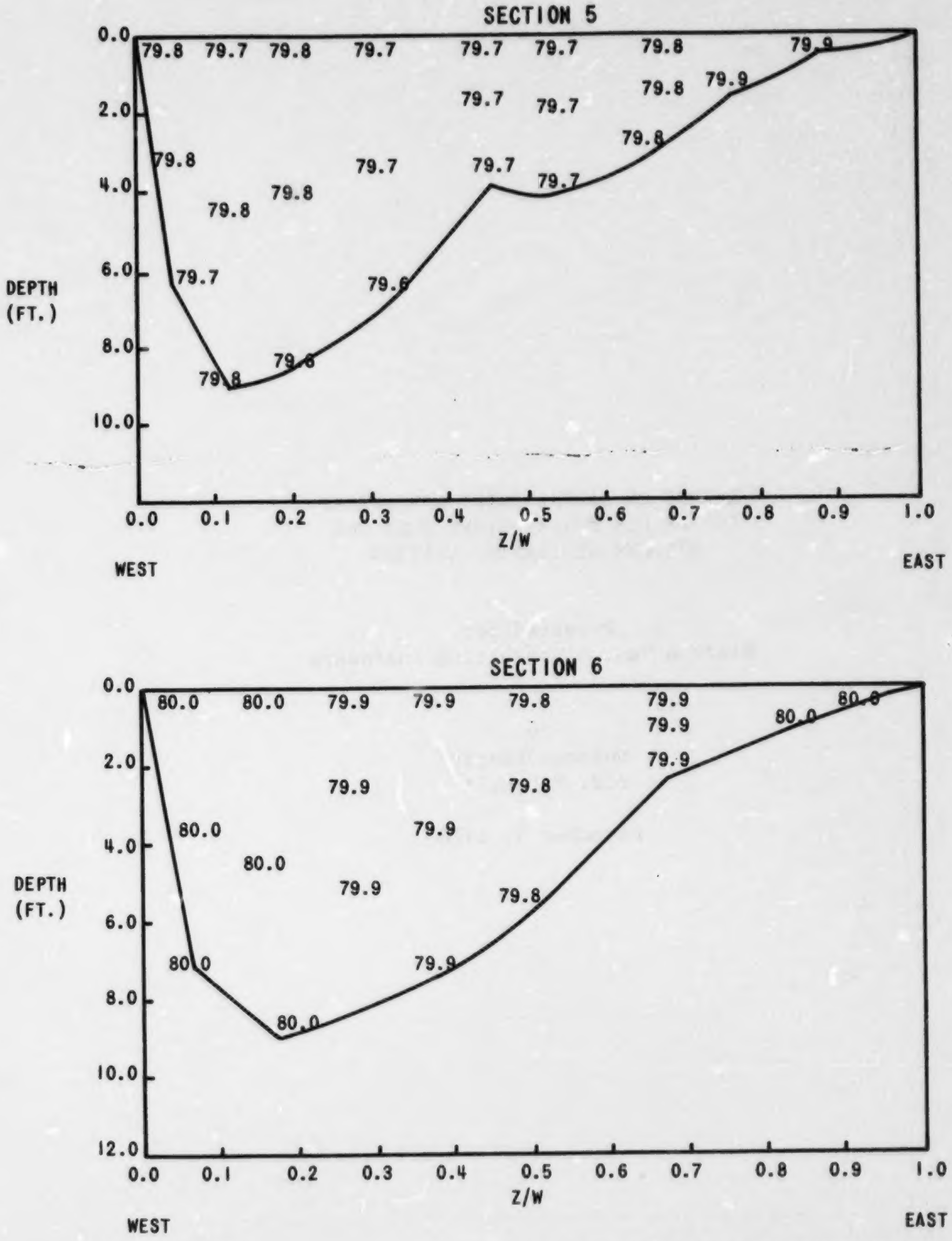


DEPTH PROFILES--DES MOINES RIVER


SECTION 3


SECTION 4

DEPTH PROFILES--DES MOINES RIVER



DEPTH PROFILES--DES MOINES RIVER

REPORT ON LARVAL DRIFT ASSESSMENT IN THE DES MOINES RIVER NEAR THE OTTUMWA GENERATING STATION

Prepared for
Black & Veatch Consulting Engineers

by
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December 9, 1976

INTRODUCTION

Larval drift studies were conducted on the Des Moines River north of Chillicothe, Iowa from May 1, 1976 to August 9, 1976. These studies were initiated in order to determine the extent of larval drift in the vicinity of the proposed make up water intake structure for the Ottumwa Generating Station.

METHODS

Three sampling stations were established approximately 500 feet upstream from the proposed intake structure, as shown in Figure 1. Vertical transects were made at Stations 1 and 3 on the west and east banks of the river. Both surface and bottom samples were taken. Due to high velocities, difficulties encountered while maneuvering the boat with the nets in tow, and the amount of sand collected in the samples, only surface samples were collected at Station 2 in mid-river.

Samples were collected in two Wildco Stream Drift Nets and buckets, with frame sizes of 12 x 18 inches and mesh size of 363 microns. These nets were attached to a mobile, light weight steel frame as shown in Figures 2 and 3. Detachable weights and floats enabled surface and bottom sampling.

During sample collection at Stations 1 and 3 the boat was anchored and velocities were determined at the surface and bottom depths utilizing a Price AA current meter. The velocity readings were then used in the following equation to determine the time interval required for 50 cubic meters of water (m^3) to pass through each net:

$$\text{Volume} = (\text{Set time, sec})(\text{velocity, fps})(1.5\ ft^2)(28.32\ l/ft^3)(1\ m^3/1000\ l)$$

where: Volume = 50 m^3 of water passing through the net
Set time = time interval the nets are kept in the water
Velocity = velocity at each sampling station
1.5 ft^2 = inlet area of the net (12" x 18"/144 in^2/ft^2)

The nets were placed in the water for the time intervals calculated. This

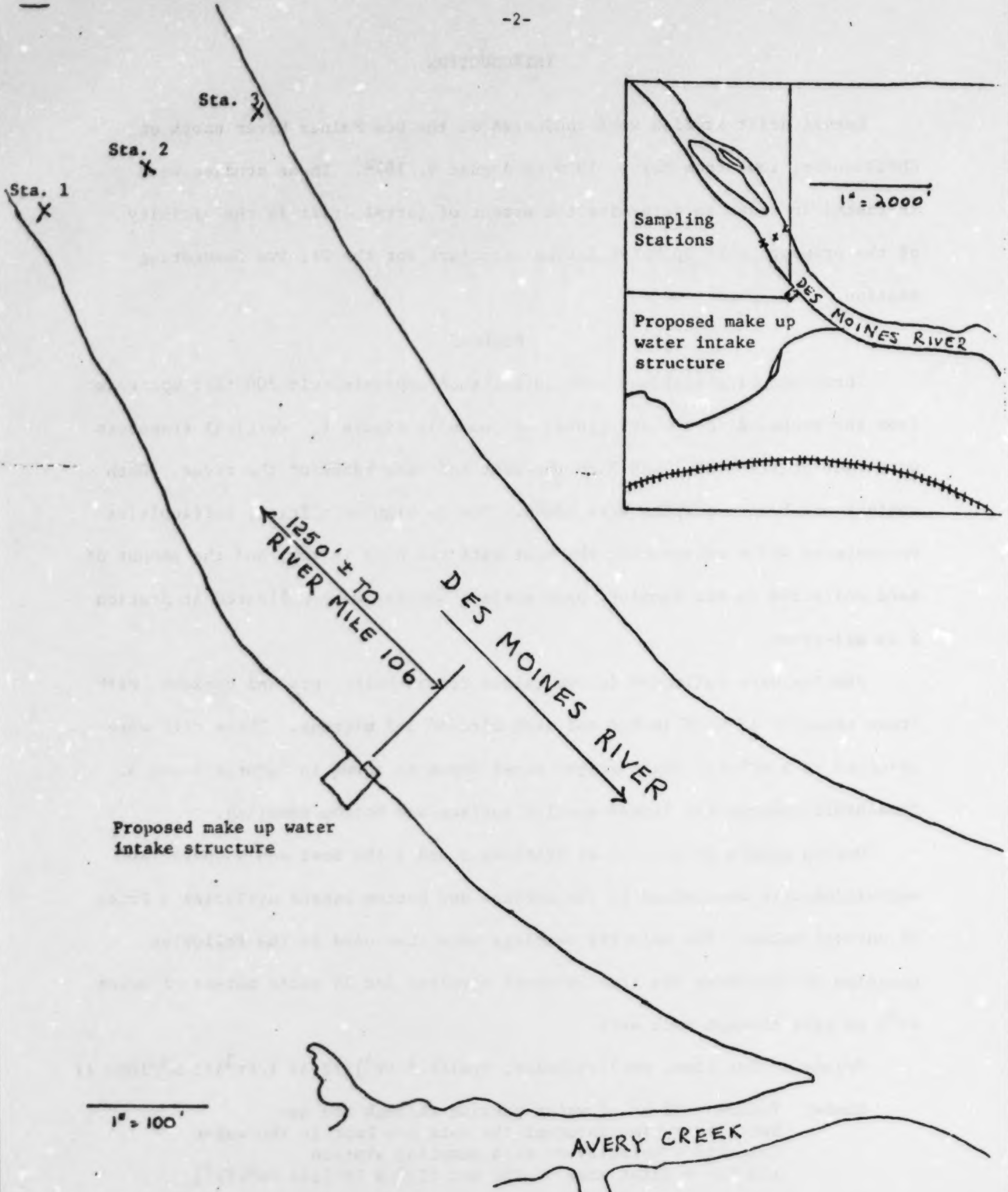
Sta. 3
Sta. 2
Sta. 1
1250' ± TO RIVER MILE 106
DES MOINES RIVER
Proposed make up water intake structure
1" = 100'
AVERY CREEK
1" = 2000'
Sampling Stations
DES MOINES RIVER
Proposed make up water intake structure

Figure 1. Location of Intake Structure and Sampling Locations.

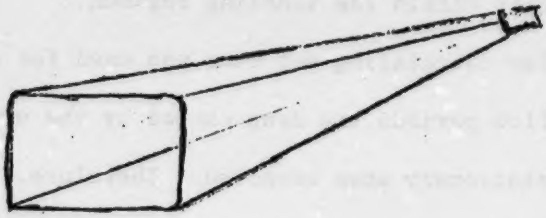

Figure 2. Wildco Stream Drift Net

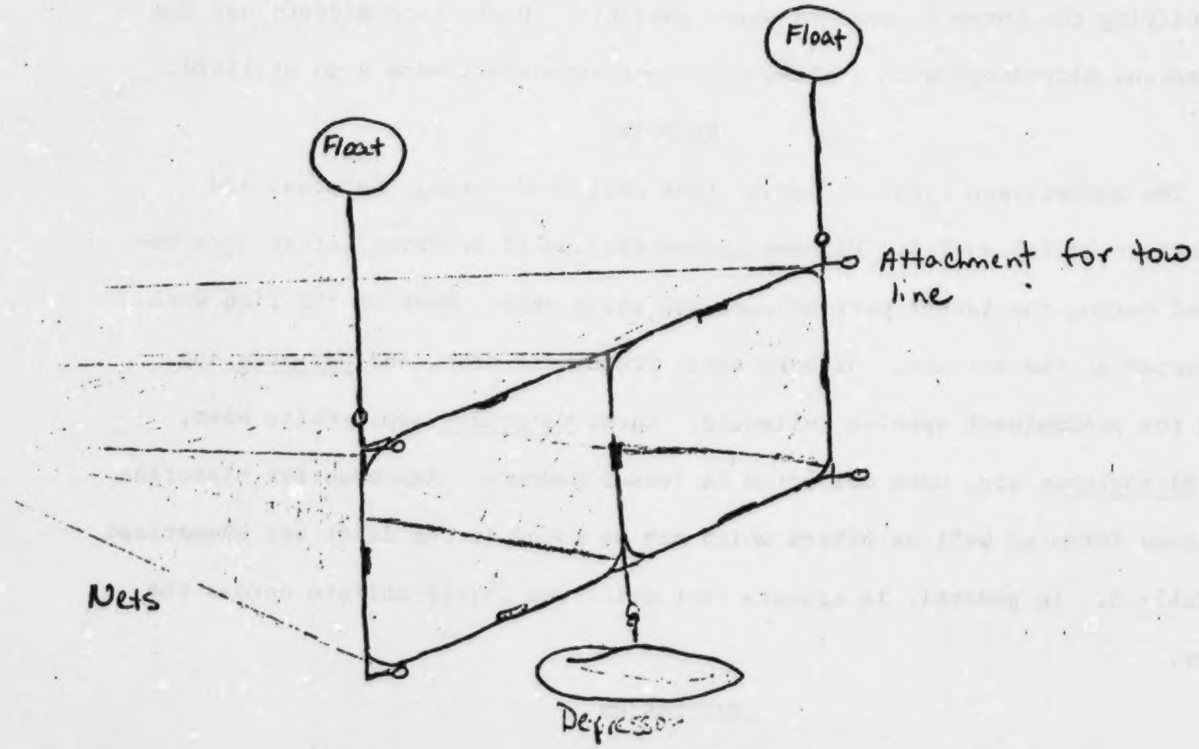

Figure 3. Frame Apparatus for towing or setting the drift nets

restriction of volume to 50 m^3 of water ensured a representative sampling volume as well as uniformity within the sampling regimen.

The same procedure for calculating set time was used for Station 2 with one variation. At high flow periods the drag caused by the nets was such that the boat did not remain stationary when anchored. Therefore, the boat was kept as stationary as possible by running the boat upstream against the current while determining velocity and placing the nets in the water for the appropriate time period.

All samples were preserved in 10% formalin and transferred to the Water Laboratory, University of Iowa, for analysis. Larval and juvenile fishwere removed from each sample and placed in labelled vials containing 5% formalin for taxonomic classification. Classification of the ichthyoplankton was completed with the aid of all of the references found at the end of this report, identifying the forms to species where possible. Dissecting microscopes and a compound microscope with a phase condenser attachment were also utilized.

RESULTS

The numbers and types of larval fish collected during the study are summarized in Tables 1-4. Highest concentrations of drifting larvae were observed during the latter part of June and early July. Most of the fish were collected at the surface. Gizzard shad, freshwater drum, and *Notropis* spp. were the predominant species collected. Carp, *Carpoides* spp., white bass, and *Micropterus* spp. were collected in lesser numbers. Reproductive histories of these forms as well as others which may be found in the drift are summarized in Table 5. In general, it appears that drift was fairly uniform across the river.

DISCUSSION

It is obvious from this study that entrainment of ichthyoplankton by the Ottumwa Generating Station cooling water system will not be a significant problem.

The majority of drift in the study occurred during high flow periods as indicated in Tables 1 and 5.

During the month of June when maximum concentrations of larval fish were collected (69% of the May 1 - August 9, 1976 total), the mean discharge in the Des Moines River was 12,400 cfs as recorded during the 1970-1975 period (Table 5). Since maximum make up water intake is 15.5 cfs, a maximum of 0.13% of the river volume and of the June larval drift would be entrained by the plant, assuming uniform distribution of the drift in the river. During the 1970-1975 record period, the lowest daily flow reported in June was 2,400 cfs while the lowest daily flow recorded for June 1976 was 3,570 cfs. Assuming a flow of 2,400 cfs during June, again less than 1% of the river volume will be utilized by the plant's cooling water system. Even at extremely low flow periods of 300 cfs, entrainment should be insignificant. Under these most adverse conditions only 5.2% of the river flow will be used for make up water and therefore a maximum of 5.2% of the drift would be entrained. Again, this is assuming a uniform distribution of drifting larvae in the river.

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Table 1. Numbers of Larval Fish Collected in Each Sample

Date	Station	Vol. through net (m^3)	(ft^3)	Number larval fish collected	Comments
May 1, 1976	1 top sample A			0	Inventory sample to determine if drift occurring in area. River Temp = 17°C Mean Discharge:* 17,200 cfs
	B			0	
	1 bottom sample A			0	
	B			0	
May 7, 1976	1 top sample A	49	1730	0	Net caught on the motor at station 2 ∴ only one sample was taken at 2 bottom and at 3 top and bottom. River Temp = Unknown Mean Discharge: 14,800 cfs
	B			0	
	1 bottom sample A	50	1766	0	
	B			0	
	2 top sample A	48	1695	0	
	B			0	
	2 bottom sample A	52	1836	0	
	3 top sample A	52	1836	0	
	3 bottom sample A	52	1836	0	
May 20, 1976	1 top sample A	50	1766	4	River Temp = Unknown Mean Discharge: 12,900 cfs
	B			1	
	1 bottom sample A	49	1730	0	
	B			1	
	2 top sample A	51	1801	0	
	B			0	
	2 bottom sample A	33	1165	0	
	B			0	
	3 top sample A	50	1766	0	
	B			0	
	3 bottom sample A	48	1695	0	
	B			0	
June 5, 1976	1 top sample A	57	2013	2	River down approximately 5 feet since beginning of study. River Temp = 24°C Mean Discharge: 6,470 cfs
	B			0	
	1 bottom sample A	52	1836	0	
	B			1	
	2 top sample A	50	1766	0	
	B			0	
	3 top sample A	49	1730	3	
	B			8	
	3 bottom sample A	50	1766	0	
	B			0	
June 17, 1976	1 top sample A	51	1801	29	River Temp = 25°C Mean Discharge: 14,700 cfs
	B			9	
	1 bottom sample A	50	1766	6	
	B			7	
	2 top sample A	52	1836	26	
	B			69	
	3 top sample A	49	1730	34	
	B			59	
	3 bottom sample A	48	1695	4	
	B			2	

*Mean Discharge: Recorded daily at Ottumwa, Iowa by U. S. Geological Survey.

Table 1 continued

Date	Station	Vol. through net (m^3)	(ft^3)	Number larval fish collected	Comments
July 1, 1976	1 top sample A	51	1801	24	River down about 1-2 feet from previous sampling run. River Temp = 21°C Mean Discharge: 9,030 cfs
	B			16	
	1 bottom sample A	51	1801	0	
	B			0	
	2 top sample A	50	1766	1	
	B			1	
	3 top sample A	49	1730	18	
	B			18	
	3 bottom sample A	50	1766	0	
	B			3	
July 19, 1976	1 top sample A	52	1836	5	River down 10-15 feet since beginning of study. Since the water was so shallow (3 feet deep at stations 1 & 3 and 1½ feet deep at station 2), only top samples were taken at stations 1 and 2. River Temp = 28°C Mean Discharge: 918 cfs
	B			12	
	1 bottom sample A			no sample	
	B				
	2 top sample A	51	1801	4	
	B			3	
	3 top sample A	50	1766	3	
	B			3	
	3 bottom sample A			no sample	
	B				
Aug. 9, 1976	Mouth of Avery Creek to proposed intake structure site (top) sample A	42	1483	0	Water was extremely shallow, station 1 being non-existent (sandbar only). Tows were made due to low velocity conditions immediately below station 1. Water was only 6" deep at station 2 ∴ no samples were collected.
	B			0	
	From proposed intake site to station 1 (top) sample A	8	283	1	
	B			0	
	3 top sample A	51	1801	0	Normal set except water only 3 ft. deep ∴ only on set of samples collected. River temp = 26°C, Mean Discharge: 890 cfs
	B			0	

Table 2. Species Identification

Station 1

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
May 20, 1976							
Notropis	9	White Bass	7	0		Carpoides spp.	7
Notropis	8						
Notropis	6						
June 5, 1976							
Notropis	10						
Gizzard Shad	13			0		Unidentified	11
Carpoides spp.	7						
June 17, 1976							
Gizzard Shad	7	Gizzard Shad	9	Gizzard Shad	10.5	Gizzard Shad	6.5
Gizzard Shad	7	Gizzard Shad	8	Gizzard Shad	8	Gizzard Shad	6.5
Gizzard Shad	7.5	Gizzard Shad	7	Gizzard Shad	8	Gizzard Shad	7
Gizzard Shad	7.5	Gizzard Shad	7	Freshwater Drum	5.5	Gizzard Shad	8
Gizzard Shad	8	Gizzard Shad	9	Unidentified	4	Freshwater Drum	8
Gizzard Shad	7	Freshwater Drum	15	Unidentified	7.5	Freshwater Drum	12
Gizzard Shad	8	Freshwater Drum	8			Carp	8.5
Gizzard Shad	10	Notropis	5				
Gizzard Shad	8.5	Unidentified	5				
Gizzard Shad	5						
Gizzard Shad	7						
Gizzard Shad	7						
Gizzard Shad	18						
Gizzard Shad	16						
Freshwater Drum	13						
Freshwater Drum	6.5						
Freshwater Drum	9						
Freshwater Drum	6.5						
Freshwater Drum	6.5						
Freshwater Drum	6.5						
Freshwater Drum	8						
Freshwater Drum	4						
Freshwater Drum	6						
Freshwater Drum	6						
Freshwater Drum	5						
Freshwater Drum	5						
Notropis	5						

Table 2 continued

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
			June 17, 1976 continued				
Notropis	5						
Notropis	5						
Unidentified	5						
			July 1, 1976				
Gizzard Shad	10	Gizzard Shad	10	0		0	
Gizzard Shad	9.5	Gizzard Shad	8				
Gizzard Shad	11.5	Gizzard Shad	12				
Gizzard Shad	12	Gizzard Shad	10				
Gizzard Shad	9.5	Gizzard Shad	7				
Gizzard Shad	9.5	Gizzard Shad	10				
Gizzard Shad	9.5	Gizzard Shad	9				
Gizzard Shad	9	Gizzard Shad	8.5				
Gizzard Shad	9	Gizzard Shad	8				
Gizzard Shad	9	Gizzard Shad	13				
Gizzard Shad	10	Gizzard Shad	13				
Gizzard Shad	9.5	Gizzard Shad	10				
Gizzard Shad	12.5	Gizzard Shad	6				
Gizzard Shad	9.5	Freshwater Drum	5				
Gizzard Shad	12	Freshwater Drum	7				
Gizzard Shad	8	Freshwater Drum	7				
Gizzard Shad	9	Freshwater Drum	15				
Gizzard Shad	8	Carpoides spp.	9				
Gizzard Shad	9						
Freshwater Drum	17.5	Unidentified	4				
Freshwater Drum	7.5						
Freshwater Drum	7						
Notropis	6.5						
Notropis	8		July 19, 1976				
Gizzard Shad	10	Gizzard Shad	10	No Sample		No Sample	
Gizzard Shad	10.5	Gizzard Shad	9				
Gizzard Shad	11	Gizzard Shad	9.5				

Table 2 continued

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
			July 19, 1976 continued				
Gizzard Shad	11	Gizzard Shad	9				
Notropis	5.5	Gizzard Shad	12				
		Gizzard Shad	9				
		Gizzard Shad	13				
		Gizzard Shad	12				
		Gizzard Shad	10.5				
		Gizzard Shad	10				
		Unidentified	4				
		Unidentified	4.5				
			August 9, 1976				
INTAKE STRUCTURE SITE TO STATION 1, SURFACE SAMPLE							
Unidentified	4						

Unidentified = Due to damaged conditon

Table 3. Species Identification

Station 2

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
June 17, 1976							
Gizzard Shad	33	Gizzard Shad	35	No Sample		No Sample	
Gizzard Shad	25	Gizzard Shad	26				
Gizzard Shad	25	Gizzard Shad	30				
Gizzard Shad	33	Gizzard Shad	31				
Gizzard Shad	25	Gizzard Shad	25				
Gizzard Shad	24	Gizzard Shad	27				
Gizzard Shad	15	Gizzard Shad	9				
Gizzard Shad	17.5	Gizzard Shad	17				
Gizzard Shad	17.5	Gizzard Shad	9				
Gizzard Shad	19	Gizzard Shad	12				
Gizzard Shad	18	Gizzard Shad	10.5				
Gizzard Shad	14.5	Gizzard Shad	22				
Gizzard Shad	17.5	Gizzard Shad	17				
Gizzard Shad	17.5	Gizzard Shad	15				
Gizzard Shad	20	Gizzard Shad	12.5				
Gizzard Shad	19	Gizzard Shad	14				
Gizzard Shad	7	Gizzard Shad	10				
Gizzard Shad	11	Gizzard Shad	6.5				
Gizzard Shad	7.5	Freshwater Drum	10.5				
Gizzard Shad	8	Freshwater Drum	9				
Gizzard Shad	8	Freshwater Drum	7				
Gizzard Shad	8	White Bass	22				
Gizzard Shad	8	White Bass	23				
Gizzard Shad	8	Carpoides spp.	8				
Gizzard Shad	8.5	Carp	21.5				
Gizzard Shad	8	Unidentified	4				
Gizzard Shad	8.5						
Gizzard Shad	8						
Gizzard Shad	8.5						
Gizzard Shad	9						
Gizzard Shad	8.5						
Gizzard Shad	8						
Gizzard Shad	8						
Gizzard Shad	13.5						
Gizzard Shad	15						
Gizzard Shad	9						

Table 3 continued

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
June 17, 1976 continued							
Gizzard Shad	9			No sample		No Sample	
Gizzard Shad	9						
Gizzard Shad	8						
Gizzard Shad	8						
Gizzard Shad	9						
Gizzard Shad	8						
Gizzard Shad	8						
Gizzard Shad	9						
Gizzard Shad	8						
Gizzard Shad	8						
Freshwater Drum	24						
Freshwater Drum	9						
Freshwater Drum	5						
Freshwater Drum	7						
Freshwater Drum	6						
Freshwater Drum	5						
Freshwater Drum	5						
Freshwater Drum	9						
Carpoides spp.	7.5						
Carpoides spp.	7.5						
Carpoides spp.	8						
Carpoides spp.	8						
Notropis	5						
Notropis	7.5						
Notropis	6.5						
Notropis	7						
Notropis	7.5						
Notropis	5						
Notropis	5						
Notropis	8						
Micropterus spp.	32.5						
Micropterus spp.	[illegible]						
Carp	10						

Table 3 continued

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
July 1, 1976							
Carpoides spp.	10	Carpoides spp.	10	No Sample		No Sample	
July 19, 1976							
Gizzard Shad	13	Gizzard Shad	8	No Sample		No Sample	
Freshwater Drum	10	Gizzard Shad	12				
Freshwater Drum	8	Freshwater Drum	16				
Unidentified	5						

Unidentified = Due to damaged condition

Table 4. Species Identification

Station 3

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
June 5, 1976							
Gizzard Shad	13	Gizzard Shad	14	0		0	
Gizzard Shad	12	Gizzard Shad	13.5				
White Bass	19	Gizzard Shad	13.5				
		Gizzard Shad	13				
		Gizzard Shad	12.5				
		White Bass	13				
		Notropis	6				
		Notropis	6.5				
June 17, 1976							
Gizzard Shad	9	Gizzard Shad	10	Gizzard Shad	9.5	Gizzard Shad	7
Gizzard Shad	10.5	Gizzard Shad	20	Freshwater Drum	5.5	Carp	5
Gizzard Shad	10	Gizzard Shad	8	Freshwater Drum	6.5		
Gizzard Shad	8	Gizzard Shad	8	Carp	7.0		
Gizzard Shad	10	Gizzard Shad	8				
Gizzard Shad	7	Gizzard Shad	7.5				
Freshwater Drum	4	Gizzard Shad	8				
Freshwater Drum	7.5	Gizzard Shad	7				
Freshwater Drum	5.5	Freshwater Drum	7				
Freshwater Drum	5	Freshwater Drum	7				
Freshwater Drum	5	Freshwater Drum	6				
Notropis	11	Freshwater Drum	7				
Notropis	11	Freshwater Drum	7				
Notropis	10	Freshwater Drum	5				
Notropis	10	Freshwater Drum	7				
Notropis	8.5	Freshwater Drum	7				
Notorpis	8.0	Freshwater Drum	7				
Notropis	7.5	Freshwater Drum	6.5				
Notropis	7.5	Freshwater Drum	6				
Notropis	6.5	Freshwater Drum	6				
Carpoides spp.	15	Freshwater Drum	7				
Carpoides spp.	15	Freshwater Drum	7				
Carpoides spp.	10	Carpoides spp.	14				
Carpoides spp.	10	Carpoides spp.	15				
Carp	7	Carpoides spp.	16				

Table 4 continued

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
			June 17, 1976 continued				
		Carpoides spp.	17				
		Carpoides spp.	13				
		Carpoides spp.	14				
		Carpoides spp.	12				
		Carpoides spp.	13				
White Bass	30	Carpoides spp.	10.5				
White Bass	25	Carpoides spp.	13				
White Bass	17.5	Carpoides spp.	7				
White Bass	12	Carpoides spp.	11				
White Bass	12	Notropis	12				
Unidentified	13	Notropis	10				
Unidentified	7	Notropis	10				
Unidentified	6	Notropis	9				
Unidentified	9	Notropis	9				
		Notropis	7				
		Notropis	7.5				
		Notropis	6.5				
		Notropis	8.5				
		Notropis	7.5				
		Notropis	7.5				
		Notropis	7				
		Notropis	7				
		Notropis	10				
		Notropis	7.5				
		Notropis	7.5				
		Notropis	8				
		Notropis	7.5				
		Notropis	7				
		Notropis	6				
		Notropis	8				
		White Bass	22				
		White Bass	18.5				
		White Bass	12				
		Unidentified	7				

Table 4 continued

SURFACE				BOTTOM			
Sample A		Sample B		Sample A		Sample B	
Species	Length (mm)	Species	Length (mm)	Species	Length (mm)	Species	Length (mm)
July 1, 1976							
Gizzard Shad	10	Gizzard Shad	11	0		Gizzard Shad	12.5
Gizzard Shad	14	Gizzard Shad	11			Gizzard Shad	15
Gizzard Shad	9.5	Gizzard Shad	10				
Gizzard Shad	8.5	Gizzard Shad	8				
Gizzard Shad	9.5	Gizzard Shad	9				
Gizzard Shad	8.5	Gizzard Shad	10				
Gizzard Shad	11	Gizzard Shad	9				
Gizzard Shad	8.5	Gizzard Shad	10				
Gizzard Shad	7	Gizzard Shad	8				
Gizzard Shad	8	Gizzard Shad	10				
Gizzard Shad	9	Gizzard Shad	10				
Gizzard Shad	8	Gizzard Shad	10				
Gizzard Shad	8	Gizzard Shad	9				
Gizzard Shad	17.5	Gizzard Shad	7				
Gizzard Shad	14	Gizzard Shad	12				
Freshwater Drum	7	Freshwater Drum	23				
Freshwater Drum	6.5	Unidentified	5				
Unidentified	8						
July 19, 1976							
Gizzard Shad	10	Gizzard Shad	10	0		0	
Gizzard Shad	9	Gizzard Shad	11				
Gizzard Shad	11	Gizzard Shad	12				
August 9, 1976							
0		0		No Sample		No Sample	

Unidentified - Due to damaged condition

Table 5. Reproduction Histories of Ichytoplankton Taxa Likely to be Found in the Des Moines River Near the Ottumwa Generating Station

Species	Spawning period	Spawning temperature (°C)	Incubation days	Spawning habitat	Number of eggs	References
Gizzard Shad	Early May through June	18-27	1.5-7	Adhesive eggs broadcast in shallow areas usually less than 3 feet in depth	22,000-544,000	Bodola, 1966; Dendy, 1946; Jester, 1962; Jester, et. al., 1972; Mayhew, 1957.
Northern Pike	Early April to early May	4.4-18.5	4-5	Adhesive eggs deposited over vegetation in marshy areas along streams or connected sloughs, in shallow water usually less than 12 inches.	7,700-97,300	Franklin and Smith, 1963; Scott and Crossman, 1973; Threinen, et. al., 1966.
Cyprinidae	Mid-April through August	14.5-25.5	1-1.5	Adhesive eggs broadcast at random over a variety of substrates and depths	1,500-2,000,000	Harlan and Speaker, 1956; Starrett, 1951.
Carp	Mid-May to Early August	17-24	3-6	Adhesive eggs broadcast at random over muck bottoms, plant beds, debris in shallow water of less than 4 feet and usually less than 1 foot.	20,000-2,000,000	Frey, 1940; Jester 1974; Sigler, 1958; See, et. al., 1966.
Ictiobus spp.	Late April to early June	13.9-23.9	4-5	Adhesive eggs randomly broadcast over mud bottoms, vegetation in shallow calm areas.	150,000-250,000	Johnson, 1963; Scott and Crossman, 1973; Walburg and Nelson, 1966; Wrenn and Grinstead, 1968.
Channel Catfish	End of May through July	21-29	5-10	Eggs deposited in gelatinous mass in nests built under logs, rocks and overhanging banks in protected water.	2,000-70,000	Clemens and Snead 1957, Cross, 1951; Katz, 1954; Miller, 1966; Scott and Crossman, 1973.
White Bass	Late May to Mid June	14.4-24	2-3	Adhesive eggs broadcast near surface or in midwater over gravelly or rocky bottoms.	140,000-994,000	Ruelle, 1971; Scott and Crossman, 1973.
Pomoxis spp.	Early May to Mid June	14-23	2-5	Builds nest in shallow water near brush, stumps, often on plant material.	11,000-194,000	Goodson, 1966; Siefert, 1968; 1969.
Freshwater Drum	May through August	18-24.5	1-2	Open water and at surface.	43,000-508,000	Daiber, 1953; Swedberg and Walburg, 1970.
Walleye	March to Mid-May	2.2-15.6	10-20	Adhesive eggs broadcast in shallow gravelly or sandy areas or in tributary streams.	35,000-6000,000	Johnson, 1961; Scott and Crossman, 1973.

Table 5 continued

Species	Spawning period	Spawning temperature (°C)	Incubation days	Spawning habitat	Number of eggs	References
Carpoides spp.	April - June			Eggs scattered over sand or mud bottom, shallow water		Lippson and Moran, 1974; Mansuetti and Hardy, 1967.
Micropterus spp.	May - July	15.5 - 25	3-4	Adhesive eggs deposited in nests, may or may not have preference for gravel bottom	2,500-10,000	Lippson and Moran, 1974; pflieger, 1975.

NOTE: Some species or genera were omitted due to the unlikelihood of presence as ichthyoplankton in the study area.

SOURCE; Adapted from *Operational Environmental Monitoring in the Mississippi River Near Quad-Cities Station, February 1975 Thrugh January 1976 Text*, Table 7.1, pp. 231-232, NALCO Environmental Sciences, Northbrook, Illinois.

Table 6

Summary of Des Moines River Flows at Ottumwa
Water Years 1970-1974 (in thousands of cfs)

	1970			1971			1972			1973			1974			1975		
Month	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.
Oct.	2.9	1.9	1.0	13.2	4.4	.7	.5	.4	.2	10.6	5.8	2.7	22.1	18.4	15.2	1.2	.6	.5
Nov.	3.9	2.1	1.2	6.1	3.4	1.3	3.6	1.7	.7	17.0	13.8	7.8	17.4	11.3	4.7	4.1	2.1	1.1
Dec.	2.0	1.2	.8	5.6	2.9	1.5	4.2	1.6	.4	10.2	5.5	2.9	16.4	10.8	5.2	4.0	1.9	.5
Jan.	3.2	1.0	.5	1.6	1.2	.6	1.7	.8	.5	18.2	12.4	5.6	19.9	8.8	4.0	3.8	1.4	.6
Feb.	3.0	1.6	.8	31.3	9.4	.9	2.9	.9	.4	27.0	16.5	7.2	14.8	9.1	4.6	2.6	1.3	.9
Mar.	13.2	6.1	1.3	26.3	18.6	9.4	6.2	4.7	2.6	27.7	16.8	6.5	21.1	12.8	7.0	24.1	7.5	.9
Apr.	13.0	7.7	5.0	18.2	9.7	4.5	7.1	3.1	1.6	31.6	24.6	15.4	17.5	12.6	6.9	20.0	16.4	12.9
May	17.0	10.0	3.4	7.9	5.5	3.4	19.5	10.8	5.8	32.0	24.8	18.1	24.2	15.2	8.0	18.4	11.8	5.6
June	8.1	4.7	2.4	12.5	6.6	2.8	13.9	8.8	4.1	23.7	19.2	17.9	26.6	18.6	15.4	19.5	16.6	13.6
July	2.1	1.4	1.0	9.8	4.4	2.2	13.2	6.0	2.3	22.9	19.6	18.3	21.6	15.6	9.0	17.5	9.3	1.5
Aug.	13.5	2.7	.5	1.6	1.0	.3	17.7	9.7	2.7	19.8	17.4	13.7	8.8	4.9	1.6	7.6	1.8	.7
Sept.	10.6	2.8	.3	1.1	.4	.05	15.7	7.7	1.3	23.4	7.0	3.5	1.5	1.0	.6	7.3	1.9	.7

Table 6 continued

Summary of Water Years
1970 - 1975

Month	Maximum (in 6 yr. period)	Mean (in 6 yr. period)	Minimum (in 6 yr. period)
October	22.1	5.3	.2
November	17.4	5.7	.7
December	16.4	4.0	.4
January	19.9	4.3	.5
February	31.3	6.5	.4
March	27.7	11.1	.9
April	31.6	12.4	3.1
May	32.0	13.0	3.4
June	26.6	12.4	2.4
July	22.9	9.4	1.0
August	19.8	6.3	.3
September	23.4	3.5	.05

APPENDIX C

TERRESTRIAL BIOLOGICAL DATA

TABLE C-1

Terrestrial mammals seen (s), captured (c) or expected (e) on the Ottumwa site

Species	Habitat	Range in Region or state	Abundance in region	Range in U.S.	Project Impact
Opossum (s) Didelphis marsupialis	Woodlands and Forest	Statewide	Common	Entire U.S.	Minimal
Short-tailed shrew (c) Blarina brevicauda	Mesic grasslands, and woods	Statewide	Common	Eastern U.S.	Minimal
Least shrew (e) Cryptotis parva	Grasslands, esp. with brush	Statewide	Rare	Eastern U.S.	Moderate, local population
Masked shrew (c) Sorex cinereus	Grasslands and fencerows	Northern 2/3 of state	Occasional	Northern U.S.	Minimal
Eastern Mole (s) Scalopus aquaticus	Grasslands	Statewide	Occasional	Eastern U.S.	Minimal
Cottontail Rabbit (s) Sylvilagus floridanus	Grasslands and brush	Statewide	Abundant	Eastern 2/3	Minimal
Woodchuck (s) Marmota monax	Grasslands	Statewide	Occasional	Eastern U.S.	Minimal
Thirteen-lined ground squirrel (s) Spermophilus tridecemlineatus	Grasslands	Statewide	Occasional	Central U.S.	Minimal
Eastern Chipmunk (s) Tamias striatus	Woods and brush	Statewide	Occasional	Eastern U.S.	Minimal
Fox squirrel (s) Sciurus niger	Woodland and forest	Statewide	Common	Eastern 2/3	Minimal

TABLE C-1 (cont.)

Species	Habitat	Range in Region or state	Abundance in region	Range in U.S.	Project Impact
Gray Squirrel (e) Sciurus carolinensis	Forests, esp. with nut trees	Statewide	Occasional	Eastern U.S.	Minimal
Flying squirrel (e) Glaucomys volans	Woods	Statewide	Rare	Eastern U.S.	Moderate, local population depression
Plains pocket gopher (s) Geomys bursarius	Grasslands	Statewide	Common	Central Plains	Minimal
Meadow jumping mouse (c) Zapus hudsonius	Mesic grasslands and open areas	Statewide	Rare	Northern and eastern	Moderate, local population depression
Western harvest mouse (e) Reithrodontomys megalotis	Mesic grassland	Statewide	Occasional	Western U.S., except northern Rockies	Moderate, local population depression
Deer mouse (c) Peromyscus maniculatus	Drier grasslands and open woods	Statewide	Common	Entire U.S. except S.E.	Minimal
White-footed mouse (c) Peromyscus leucopus	Woods and brush, occas. open areas	Statewide	Abundant	Eastern 2/3	Minimal
Meadow vole (c) Microtus pennsylvanicus	Mesic grasslands	Mostly northern 2/3 of state	Occasional	Northern	Minimal
Prairie vole (c) Microtus ochrogaster	Dry grasslands	Mostly southern 2/3 of state	Rare	Northern Plains	Moderate, local population depression

TABLE C-1 (cont.)

Species	Habitat	Range in Region of state	Abundance in region	Range in U.S.	Project Impact
Pine vole (e) Pitymys pinetorum	Forests with heavy litter layer	Eastern ½ of state	Rare	Eastern U.S.	Moderate, local population depression
Southern bog lemming (e) Synaptomys cooperi	Wet meadows	Statewide	Rare	Eastern U.S., north of Tenn.	Moderate, local population depression
Muskrat (s) Ondatra zibethica	Marshes, stream edges, swamps	Statewide	Occasional	Most of U.S.	Minimal
House mouse (c) Mus musculus	Fields, around human habitation	Statewide	Common	Entire U.S.	Minimal
Norway rat (s) Rattus novegicus	Around human habitation and farms	Statewide	Common near farms	Entire U.S.	Minimal
Raccoon (s) Procyon lotor	Woods with access to water	Statewide	Occasional	Most of U.S. except western mountains	Minimal
Coyote (e) Canis latrans	Prairies and open brush	Statewide	Occasional	U.S. west of Appalachians	Minimal
Gray fox Urocyon cinereoargenteus	Woods and edges	Statewide	Rare	Eastern and southwestern U.S.	Moderate, local population depression
Red fox (s) Vulpes fulva	Hilly areas with a mosaic of woods and open areas	Statewide	Occasional	Most of U.S. except dry steppe	Moderate, local population depression
Mink (e) Mustela vison	Along water	Statewide	Occasional	Entire U.S. except southwest	Minimal
Long-tailed weasel (e) Mustela frenata	Any habitat with access to water	Statewide	Occasional	Entire U.S. except Sonoran Prov.	Minimal

TABLE C-1 (cont.)

Species	Habitat	Range in Region or state	Abundance in region	Range in U.S.	Project Impact
Striped skunk (s) *Mephitis mephitis*	Open woods, prairies, brush	Statewide	Common	Entire U.S.	Minimal
Spotted skunk (e) *Spilogale putorius*	Open woods, prairies, brush	Statewide	Occasional	Most of U.S. except North-east	Moderate, local population depression
Badger (e) *Taxidea taxus*	Grasslands	Statewide	Rare	Western U.S.	Moderate, local population depression
White-tailed deer (s) *Odocoileus virginianus*	Woods and brushy edges	Statewide	Occasional	Most of U.S. except desert states	Moderate, local population depression

TABLE C-2

Birds of the Ottumwa Site. "Ott." indicates a highly probable presence in the area.

A - ABUNDANT
C - COMMON
U - UNCOMMON
O - OCCASIONAL
R - RARE
B - BLUE LISTED
T - THREATENED

	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
C	Common loon Gavia immer					X	X																	X			
R	Red-necked grebe Podiceps grisegena					X	X																	X			
O	Horned grebe Podiceps auritis					X	X																	X			
O	Eared grebe Podiceps caspicus					X	X																	X			
C	Pied-billed grebe Podilymbus podiceps	Ott.		X			X	X															X				
R	White pelican Pelecanus erythrorhychos					X	X																	X			
C	Double-crested cormorant Phalacrocorax auritus	Ott.		X		X	X																	X			
C	Great blue heron Ardea herodias	Ott. (seen)		X			X	X	X														X				
C	Green heron Butorides virescens	Ott. (seen)		X			X	X	X														X				
O	Little blue heron Florida caerulea			X				X	X															X			

TABLE C-2 (cont.)

A - ABUNDANT
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R - RARE
B - BLUE LISTED
T - THREATENED

			RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
	SPECIES		PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
O	Common egret Casmerodius albus			X			X	X	X															X			
U	Black-crowned night heron Nycticorax nycticorax			X				X	X															X			
R	Yellow-crowned night heron Nyctanassa violacea			X				X	X															X			
U	Least bittern Ixobrychus exilis	Ott.		X				X	X														X				
R	American bittern Botaurus lentiginosus			X		X		X	X															X			
O	Whistling swan Olor columbianus					X	X																	X			
A	Canada goose Branta canadensis	Ott. (seen)				X	X	X			X	X											X				
R	White-fronted goose Anser albifrons					X	X				X	X												X			
U	Snow goose Chen hyperborea					X	X	X			X	X												X			
A	Mallard Anas platyrhychos	Ott. (seen)		X		X	X	X	X														X				

TABLE C-2 (cont.)

A - ABUNDANT
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	SPECIES		RESIDENT STATUS: PERMANENT	SUMMER	WINTER	TRANSIENT	HABITAT PREFERENCE AND RESTRICTIONS: AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER		EFFECT OF PROJECT ACTION: HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
U	Black duck *Anas rubripes*	Ott.			X	X	X	X	X															X				
U	Gadwall *Anas strepera*	Ott.				X	X	X	X															X				
A	Pintail *Anas acuta*	Ott.				X	X	X	X															X				
C	Green-winged teal *Anas carolinensis*	Ott.				X	X	X	X															X				
A	Blue-winged teal *Anas discors*	Ott.(seen)		X		X	X	X	X															X				
C	American widgeon *Mareca americana*					X	X																		X			
C	Shoveler *Spatula clypeata*	Ott.				X	X	X	X															X				
C	Wood duck *Aix sponsa*	Ott. (seen)		X			X	X	X															X				
C	Redhead *Aythya americana*			X			X																		X			
C	Ring-necked duck *Aythya collaris*					X	X																		X			

TABLE C-2 (cont.)

A - ABUNDANT
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	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
U	Canvas-back Aythya valisineria					X	X																	X			
A	Lesser Scaup Aythya affinis	Ott.				X	X																X				
U	Common goldeneye Bucephala clangula					X	X																	X			
U	Bufflehead Bucephala albeola					X	X																	X			
R	Oldsquaw Clangula hyemalis					X	X																	X			
R	White-winged scoter Melanitta deglandi					X	X																	X			
U	Ruddy duck Oxyura jamaicensis	Ott.		X			X	X															X				
U	Hooded merganser Lophodytes cucullatus	Ott.		X			X	X	X														X				
C	Common merganser Mergus merganser	Ott.			X	X	X	X	X														X				
O	Red-breasted merganser Mergus serrator					X	X																	X			

TABLE C-2 (cont.)

A - ABUNDANT
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	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
U	Turkey vulture *Cathartes aura*	Ott. (seen)		X							X	X	X	X		X							X				
R	Goshawk *Accipiter gentilis*				X	X									X	X	X	X						X			
U	Sharp-shinned hawk *Accipiter striatus*	Ott.	X												X	X		X					X				
U	Cooper's Hawk *Accipiter cooperii*	Ott.	X												X	X		X					X				
C	Red-tailed hawk *Buteo jamaicensis*	Ott. (seen)	X								X	X	X	X	X	X							X				
R	Red-shouldered hawk *Buteo lineatus*		X							X						X								X			
C	Broad-winged hawk *Buteo platypterus*	Ott.		X		X					X	X	X	X	X	X							X				
U	Rough-legged hawk *Buteo lagopus*	Ott.			X						X	X	X	X									X				
C	Bald eagle *Haliaeetus leucocephalus*	Ott.			X	X				X													X				
C	Harrier *Circus cyaneus*	Ott. (seen)	X			X		X					X	X									X				

TABLE C-2 (cont.)

A - ABUNDANT
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R - RARE
B - BLUE LISTED
T - THREATENED

			RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
	SPECIES		PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
O	Osprey Pandion haliaetus	Ott.(seen)				X				X													X				
R	Peregrine falcon Falco peregrinus					X									X	X								X			
O	Merlin Falco columbarius					X		X				X	X	X										X			
C	Kestrel Falco sparverius	Ott.	X	X								X	X	X									X				
C	Bobwhite quail Colinus virginianus	Ott. (seen)	X								X	X	X	X									X				
A	Ring-necked pheasant Phasianus colchicus	Ott. (seen)	X								X	X	X	X									X				
R	King rail Rallus elegans				X				X															X			
C	Virginia Rail Rallus limicola	Ott.			X				X															X			
U	Sora Porzana carolina	Ott.			X				X															X			

TABLE C-2 (cont.)

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	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS																EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	SHORES	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
R	Yellow rail Coturnicops noveboracensis					X		X																	X			
R	Black rail Laterallus jamaicensis					X		X																	X			
O	Common gallinule Gallinula chloropus			X				X																	X			
C	American coot Fulica americana	Ott. (seen)		X			X	X																X				
U	Semi-palmated plover Charadrius semipalmatus					X																X			X			
A	Killdeer Charadrius vociferus	Ott. (seen)		X						X	X	X										X		X				
C	American golden plover Pluvialis dominica	Ott.				X					X	X										X		X				
U	Black-bellied plover Squatarola squatarola					X					X	X										X			X			
R	Ruddy turnstone Arenaria interpres					X																X			X			
U	American woodcock Philohela minor	Ott.		X				X	X	X														X				

TABLE C-2 (cont.)

A - ABUNDANT
C - COMMON
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O - OCCASIONAL
R - RARE
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T - THREATENED

	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS																EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	SHORES	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
C	Common snipe Capella gallinago	Ott.			X	X		X	X															X				
U	Upland plover Bartramia longicauda	Ott.		X								X	X	X										X				
C	Spotted sandpiper Actitis macularia	Ott.		X																		X		X				
C	Solitary sandpiper Tringa solitaria	Ott.				X																X		X				
R	Willet Catoptrophorus semipalmatus					X																X			X			
C	Greater yellowlegs Totanus melanoleucus	Ott.				X																X		X				
C	Lesser yellowlegs Totanus flavipes	Ott.				X																X		X				
A	Pectoral sandpiper Erolia melanotos	Ott.				X		X														X		X				
U	White-rumped sandpiper Erolia fuscicollis	Ott.				X																X		X				
U	Baird's sandpiper Erolia bairdii	Ott.				X																X		X				

TABLE C-2 (cont.)

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T - THREATENED

			RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS																EFFECT OF PROJECT ACTION					
	SPECIES		PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	SHORES	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
C	Least sandpiper _Erolia minutilla_	Ott.				X																X		X				
U	Dunlin _Erolia alpina_					X																X			X			
O	Long-billed dowitcher _Limnodromus scolopaceus_					X																X			X			
R	Stilt sandpiper _Micropalama himantropus_					X																X			X			
C	Semipalmated sandpiper _Ereunetes pusillus_	Ott.				X																X		X				
O	Hudsonian godwit _Limosa haemastica_					X																X			X			
R	Sanderling _Crocethis alba_					X																X			X			
O	Wilson's phalarope _Steganopus tricolor_					X	X															X			X			
C	Herring gull _Larus argentatus_	Ott.			X	X	X				X	X										X			X			
C	Ring-billed gull _Larus delawarensis_	Ott.			X	X	X				X	X										X			X			

TABLE C-2 (cont.)

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			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	SHORES	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
R	Franklin's gull Larus pipixcan					X	X						X									X			X			
C	Bonaparte's gull Larus philadelphia	Ott.				X	X															X			X			
C	Forster's tern Sterna forsteri	Ott.				X	X	X					X									X			X			
U	Common tern Sterna hirundo	Ott.				X	X															X			X			
O	Least tern Sterna albifrons			X			X	X														X			X			
U	Caspian tern Hydroprogne caspia	Ott. (seen)				X	X															X			X			
C	Black tern Childonias nigra	Ott.		X		X	X	X														X			X			
A	Rock dove Columba livia	Ott. (seen)	X								X	X							X	X					X			
A	Mourning dove Zenaidura macroura	Ott. (seen)	X	X							X	X	X	X	X	X								X				
C	Yellow-billed cuckoo Coccyzus americanus	Ott.		X											X	X								X				

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C	Black-billed cuckoo Cuccyzus erythropthalmus	Ott.				X									X	X								X				
R	Barn owl Tyto alba		X								X	X	X	X											X			
C	Screech owl Otus asio	Ott.	X											X	X	X								X				
C	Great-horned owl Bubo virginianus	Ott. (seen)	X										X	X	X	X		X						X				
C	Barred owl Strix varia	Ott.	X							X						X								X				
O	Long-eared owl Asio otus		X		X											X	X	X							X			
U	Short-eared owl Asio flammeus	Ott.	X		X			X				X	X	X										X				
R	Chuck-will's-widow Caprimulgus carolinensis					X				X															X			
U	Whip-poor-will Caprimulgus vociferus	Ott.		X												X								X				

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A	Common nighthawk Chordeiles minor	Ott.		X								X	X	X	X				X					X				
A	Chimney swift Chaetura pelagica	Ott.		X								X	X	X					X						X			
C	Ruby-throated hummingbird Archilochus colubris	Ott.		X									X	X	X				X					X				
C	Belted kingfisher Magaceryle alcyon	Ott. (seen)		X				X	X							X								X				
A	Flicker Colaptes auratus	Ott. (seen)	X	X								X	X	X	X									X				
C	Red-bellied woodpecker Centurus carolinus	Ott. (seen)	X							X					X	X								X				
A	Red-headed woodpecker Melanerpes erythrocephalus	Ott. (seen)	X	X								X	X	X	X									X				
C	Yellow-bellied sapsucker Sphyraicus varius	Ott.				X									X	X		X						X				
C	Hairy woodpecker Dendrocopus villosus	Ott. (seen)	X							X						X	X		X					X				
A	Downy woodpecker Dendrocopus pubescens	Ott. (seen)	X							X						X	X		X					X				

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A	Eastern kingbird Tyrannus tyrannus	Ott. (seen)		X										X	X	X							X				
C	Great crested flycatcher Myiarchus crinitus	Ott.		X											X	X							X				
C	Eastern phoebe Sayornis phoebe	Ott. (seen)		X										X	X	X							X				
U	Yellow-bellied flycatcher Empidonax flaviventris	Ott. (seen)				X											X	X					X				
R	Acadian flycatcher Empidonax virescens			X					X	X						X								X			
C	Traill's flycatcher Empidonax traillii	Ott.		X					X	X													X				
C	Least flycatcher Empidonax minimus	Ott.				X								X	X								X				
C	Eastern wood pewee Contopus virens	Ott.		X											X	X							X				
O	Olive-sided flycatcher Nuttallornis borealis					X											X							X			
A	Horned lark Eremophila alpestris	Ott.	X								X	X	X	X									X				

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U	Tree swallow Iridoprocne bicolor	Ott.		X					X	X													X				
A	Bank swallow Riparia riparia	Ott. (seen)		X						X										X			X				
C	Rough-winged swallow Stelgidopteryx ruficollis	Ott.		X																X			X				
A	Barn swallow Hirundo rustica	Ott. (seen)		X							X	X		X					X				X				
U	Cliff swallow Petrochelidon pyrrhonota	Ott.		X															X	X			X				
C	Purple martin Progne subis	Ott. (seen)		X							X	X							X				X				
A	Blue-jay Cyanocitta cristata	Ott. (seen)	X	X								X		X	X	X							X				
A	Common crow Corvus brachyrhynchos	Ott. (seen)	X								X	X	X	X	X	X							X				
A	Black-capped chickadee Parus atricapillus	Ott. (seen)	X											X	X	X							X				
C	Tufted titmouse Parus bicolor	Ott. (seen)	X											X	X	X							X				

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			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
A	White-breasted nuthatch Sitta carolinensis	Ott. (seen)	X												X	X		X					X				
U	Red-breasted nuthatch Sitta canadensis	Ott.			X												X	X					X				
U	Brown creeper Certhia familiaris	Ott.	X		X										X	X							X				
A	House wren Troglodytes aëdon	Ott. (seen)		X											X				X				X				
O	Winter wren Troglodytes troglodytes	Ott.				X				X					X	X							X				
U	Bewick's wren Thryomanes bewickii	Ott.		X												X			X				X				
R	Carolina wren Thryothorus ludovicianus		X												X									X			
C	Long-billed marsh wren Telmatodytes palutris	Ott.		X				X															X				
U	Short-billed marsh wren Cistothorus platensis	Ott.		X				X					X										X				
U	Mockingbird Mimus polyglottos	Ott. (seen)		X										X	X				X				X				

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A	Catbird Dumetella carolinensis	Ott. (seen)		X											X	X							X				
A	Brown thrasher Toxostoma rufum	Ott. (seen)		X										X	X	X							X				
A	Robin Turdus migratorius	Ott. (seen)	X	X								X	X	X	X	X							X				
C	Wood thrush Hylocichla mustelina	Ott. (seen)		X											X	X							X				
C	Hermit thrush Hylocichla guttata	Ott.				X												X					X				
C	Swainson's thrush Hylocichla ustulata	Ott.				X											X						X				
C	Gray-cheeked thrush Hylocichla minima	Ott.				X											X						X				
O	Veery Hylocichla fuscencens	Ott.				X				X						X							X				
C	Eastern bluebird Sialia sialis	Ott.	X	X										X	X								X				
U	Blue-gray gnatcatcher Polioptila caerulea	Ott.		X						X						X							X				

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C	Golden-crowned kinglet Regulus satrapa	Ott. (seen)				X										X	X	X						X				
C	Ruby-crowned kinglet Regulus calendula	Ott. (seen)				X										X	X	X						X				
O	Water pipet Anthus spinoletta					X					X	X	X	X								X			X			
R	Sprague's pipit Anthus spragueii					X						X	X												X			
R	Bohemian waxwing Bombycilla garrula				X									X	X										X			
U	Cedar waxwing Bombycilla cedrorum	Ott. (seen)		X										X	X									X				
U	Loggerhead shrike Lanius ludovicianus	Ott.		X									X	X										X				
A	Starling Sturnus vulgaris	Ott. (seen)	X								X	X		X	X				X						X			
R	White-eyed vireo Vireo griseus			X											X	X									X			
C	Bell's vireo Vireo bellii	Ott.		X						X														X				

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C	Yellow-throated vireo Vireo flavifrons	Ott.		X											X	X								X				
C	Solitary vireo Vireo solitarius	Ott.				X												X						X				
A	Red-eye vireo Vireo olivaceus	Ott.		X											X	X								X				
R	Philadelphia vireo Vireo philadelphicus					X									X	X									X			
A	Warbling vireo Vireo gilvus	Ott.		X											X	X		X						X				
C	Black and white warbler Mniotilta varia	Ott.				X									X	X								X				
C	Prothonotary warbler Protonotaria citrea	Ott.		X					X															X				
R	Worm-eating warbler Helmitheros vermivorus					X										X									X			
R	Golden-winged warbler Vermivora chrysoptera					X									X	X									X			
R	Blue-winged warbler Vermivora pinus			X					X						X										X			

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A	Tennessee warbler Vermivora peregrina	Ott.				X			X							X	X						X				
C	Orange-crowned warbler Vermivora celata	Ott.				X								X	X								X				
C	Nashville warbler Vermivora ruficapilla	Ott. (seen)				X									X								X				
R	Parula warbler Parula americana					X				X						X								X			
A	Yellow warbler Dendroica petechia	Ott.		X						X					X								X				
C	Magnolia warbler Dendroica magnolia	Ott.				X									X	X	X						X				
R	Cape May warbler Dendroica tigrina					X									X	X	X							X			
R	Black-throated blue warbler Dendroica caerulescens					X										X		X						X			
A	Myrtle warbler Dendroica coronata	Ott. (seen)				X									X	X	X	X					X				
U	Black-throated green warbler Dendroica virens	Ott.				X			X								X						X				

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R	Cerulean warbler *Dendroica cerulea*			X						X						X									X			
U	Blackburnia warbler *Dendroica fusca*	Ott.				X									X	X	X							X				
C	Chestnut-sided warbler *Dendroica pennsylvanica*	Ott.				X								X	X	X								X				
O	Bay-breasted warbler *Dendroica castanea*					X											X								X			
C	Blackpoll *Dendroica striata*	Ott.				X									X	X	X							X				
C	Palm warbler *Dendroica palmarum*	Ott.				X			X						X	X	X							X				
C	Ovenbird *Seiurus aurocapillus*	Ott.		X												X								X				
C	Northern waterthrush *Seiurus novaboracensis*	Ott.				X			X	X														X				
U	Louisiana waterthrush *Seiurus motacilla*	Ott.		X					X	X														X				
U	Kentucky warbler *Oporornis formosus*	Ott.		X						X					X	X								X				

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R	Connecticut warbler Oporornis agilis					X			X								X							X			
U	Mourning warbler Oporornis philadelphis					X			X	X					X									X			
A	Yellowthroat Geothlypis trichas	Ott. (seen)		X				X	X	X				X	X								X				
U	Yellow-breasted chat Icteria virens	Ott.		X											X								X				
R	Hooded warbler Wilsonia citrina					X			X	X						X								X			
C	Wilson's warbler Wilsonia pusilla	Ott.				X			X	X						X							X				
U	Canada warbler Wilsonia canadensis	Ott.				X				X													X				
A	American redstart Setophaga ruticilla	Ott.		X											X	X							X				
A	House sparrow Passer domesticus	Ott. (seen)	X								X	X		X	X				X					X			
C	Bobolink Dolichonyx oryzivorus	Ott.		X								X	X	X									X				

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A	Eastern meadowlark Sturnella magna	Ott. (seen)		X							X	X	X	X									X				
C	Western meadowlark Sturnella neglecta	Ott.		X							X	X	X	X									X				
C	Yellow-headed blackbird Xanthocephalus xanthocephalus			X				X																X			
A	Red-winged blackbird Agelaius phoeniceus	Ott. (seen)	X	X				X			X	X		X	X								X				
O	Orchard oriole Icterus spurius	Ott.		X										X	X								X				
A	Baltimore oriole Icterus galbula	Ott. (seen)		X											X	X							X				
C	Rusty blackbird Euphagus carolinus	Ott.				X			X	X						X							X				
U	Brewer's blackbird Euphagus cyanocephalus	Ott.				X							X	X									X				
A	Common grackle Quiscalus quiscala	Ott. (seen)	X	X							X	X	X	X	X									X			
C	Brown-headed cowbird Molothrus ater	Ott. (seen)		X							X	X	X	X	X								X				

TABLE C-2 (cont.)

A - ABUNDANT
C - COMMON
U - UNCOMMON
O - OCCASIONAL
R - RARE
B - BLUE LISTED
T - THREATENED

	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
U	Scarlet tanager Piranga olivacea	Ott.		X											X	X							X				
U	Summer tanager Piranga rubra	Ott.		X											X	X							X				
A	Cardinal Richmondena cardinalis	Ott. (seen)	X											X	X	X							X				
C	Rose-breasted grosbeak Pheucticus ludovicianus	Ott. (seen)		X						X					X	X							X				
C	Indigo bunting Passerina cyanea	Ott. (seen)		X										X	X								X				
A	Dickcissel Spiza americana	Ott. (seen)		X								X	X	X									X				
O	Evening grosbeak Hesperiphona vespertina				X	X									X	X	X	X						X			
C	Purple finch Carpodacus purpureus	Ott.			X										X		X	X					X				
R	Pine grosbeak Pinicola enucleator				X												X							X			
U	Common redpoll Acanthis flammea	Ott.			x								X	X	X								X				

TABLE C-2 (cont.)

A - ABUNDANT
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	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
U	Pine siskin Spinus pinus	Ott.			X												X						X				
C	American goldfinch Spinus tristis	Ott. (seen)		X	X							X	X	X									X				
U	Red crossbill Loxia curvirostra				X												X							X			
R	White-winged crossbill Loxia leucoptera				X												X							X			
C	Rufus-sided towhee Pipilo erythrophthalmus	Ott. (seen)		X											X	X							X				
C	Savannah sparrow Passerculus sandwishensis	Ott.		X		X							X	X									X				
C	Grasshopper sparrow Ammodramus savannarum	Ott. (seen)		X								X	X	X									X				
U	LeConte's sparrow Passerherbulus caudacutus	Ott.				X		X					X										X				
R	Henslow's sparrow Passerherbulus henslowii			X									X	X										X			
R	Sharp-tailed sparrow Ammospiza caudacuta					X		X																X			

TABLE C-2 (cont.)

A - ABUNDANT
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	SPECIES		RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS															EFFECT OF PROJECT ACTION					
			PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER	HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
C	Vesper sparrow *Pooecetes gramineus*	Ott.		X								X	X	X									X				
C	Lark sparrow *Chondestes grammacus*	Ott.		X								X	X	X									X				
A	Slate-colored junco *Junco hyemalis*	Ott. (seen)			X										X		X						X				
A	Tree sparrow *Spizella arborea*	Ott.			X										X	X							X				
C	Chipping sparrow *Spizella passerina*	Ott. (seen)		X											X				X				X				
U	Clay-colored sparrow *Spizella pallida*					X							X		X									X			
C	Field sparrow *Spizella pusilla*	Ott. (seen)		X								X		X	X								X				
O	Harris's sparrow *Zonotrichia querula*				X	X								X	X		X							X			
U	White-crowned sparrow *Zonotrichia leucophrys*	Ott.			X	X								X	X		X						X				
A	White-throated sparrow *Zonotrichia albicollis*	Ott. (seen)				X								X	X		X						X				

TABLE C-2 (cont.)

A - ABUNDANT
C - COMMON
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O - OCCASIONAL
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B - BLUE LISTED
T - THREATENED

			RESIDENT STATUS				HABITAT PREFERENCE AND RESTRICTIONS																EFFECT OF PROJECT ACTION					
	SPECIES		PERMANENT	SUMMER	WINTER	TRANSIENT	AQUATIC	MARSH	SWAMP	RIPARIAN	CROPLAND	PASTURE - HAYLAND	PRAIRIE	OLD FIELDS	FOREST EDGE	DECIDUOUS FOREST	CONIFEROUS FOREST	MIXED FOREST	URBAN	CLIFFS AND BANKS	OTHER		HIGHLY DETRIMENTAL	MODERATELY DETRIMENTAL	PRESENT STATUS OR NO APPARENT IMPACT	SLIGHTLY ADVANTAGEOUS	MODERATELY ADVANTAGEOUS	HIGHLY ADVANTAGEOUS
C	Fox sparrow Passerella iliaca	Ott. (seen)				X								X	X		X							X				
C	Lincoln's sparrow Melospiza lincolnii	Ott.				X			X	X					X									X				
C	Swamp sparrow Melospiza georgiana	Ott.		X		X		X	X	X					X									X				
A	Song sparrow Melospiza melodia	Ott. (seen)		X	X								X	X	X									X				
U	Lapland longspur Calcarius lapponicus				X	X					X	X	X												X			

TABLE C-3

Amphibians of South-east Iowa that may occur on the Ottumwa Site

Species	Habitat	Range in state	Estimated Abundance in state	Range in U.S.	Estimated Project Impact
Mudpuppy Necturus maculosus	Permanent water	Eastern 2/3	Common	Central to Appalachians	Minimal
Central newt Notophthalmus viridescens	Ponds and small streams	Eastern 1/4	Common	Eastern $\frac{1}{4}$ of U.S.	Minimal
Small-mouthed salamander Ambystoma texanum	Ponds and river-bottom forest	Southern	Rare	South-central	Local population depression
Eastern tiger salamander Ambystoma tigrinum	Ponds	Statewide	Common	East of Rockies	Minimal
American toad Bufo americanus	Anywhere if enough water for breeding	Statewide	Abundant	Eastern $\frac{1}{2}$ of U.S.	Minimal
Spring peeper Hyla crucifer	Second-growth woods near water	Eastern 1/3	Rare	Eastern 1/3 of U.S.	Local population depression
Treefrog Hyla versicolor	Trees in/near water	Statewide	Common	Eastern $\frac{1}{2}$ of U.S.	Minimal
Western chorus frog Pseudacris triseriata	Agricultural fields and prairies	Statewide	Common	East and north	Minimal
Blanchard's cricket frog Acris crepitans	River valleys and lowlands	Statewide	Common	Central and northern	Minimal

TABLE C-3 (cont.)

Species	Habitat	Range in state	Estimated Abundance in state	Range in U.S.	Estimated Project Impact
Bullfrog Rana catesbeiana	Any permanent water	Southern 1/2	Common	Eastern ½ of U.S. and west coast	Minimal
Greenfrog Rana clamitans	Shallow water, standing or running	Eastern 1/2	Common	Eastern ½ of U.S.	Minimal
Leopard frog Rana pipiens	Meadows, open	Statewide	Occasional	Northern ½ of U.S.	Minimal

Sources: Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. 2nd ed. Boston, Houghton Mifflin.

Menzel, B. W. 1975. Course manual for zoology 306, herpetology. Iowa State Univ.

TABLE C-4

Reptiles of Southeast Iowa that may occur on the Ottumwa Site

Species	Habitat	Range in state	Estimated Abundance in state	Range in U.S.	Estimated Project Impact
Turtles:					
Common snapping turtle *Chelydra serpentina*	Ponds and lakes	Statewide	Common	East of Rockies	Minimal
Map turtle *Graptemys geographica*	Large rivers and lakes	Eastern 1/4	Occasional	Mid-eastern	Minimal
Western painted turtle *Chrysemys picta*	Shallow, muddy ponds and marshes	Statewide	Common	North-central and north-western	Minimal
Blanding's turtle *Emydoidea blandingi*	Small bodies of water	North and southeast	Rare	North-central	Local population depression
Ornate box turtle *Terrapene ornata*	Grasslands, esp. sandy	Statewide	Rare	South-central	Local population depression
Smooth softshell turtle *Trionyx muticus*	Streams	Major rivers	Common	Central	Minimal
Spiny softshell turtle *Trionyx spiniferus*	Rivers and larger lakes	Statewide	Common	Central, and east to Appalachians	Minimal
Lizards:					
Western slender glass lizard *Ophisaurus attenuatus*	Dry grasslands and open woods	South-east	Rare	South-central and south-east	Local population depression

TABLE C-4 (cont.)

Species	Habitat	Range in state	Estimated Abundance in state	Range in U.S.	Estimated Project Impact
Snakes:					
Northern water snake Natrix sipedon	Any body of water, esp. quiet water	Statewide	Common	Central and east	Minimal
Graham's water snake Natrix grahami	Protected water edges	Central and south-east	Occasional	South-central	Minimal
Red-side garter snake Thamnophis sirtalis	Wide range of grasslands and woods	Statewide	Abundant	All but south-west	Minimal
Plains garter snake Thamnophis radix	Near water in grasslands	Statewide	Common	North-central	Minimal
Ribbon snake Thamnophis proximus	Semi-aquatic, water edges	South-east	Common	South-central	Minimal
Dekay's snake Storeria dekayi	Moist areas	Statewide, except north-west	Common	Eastern ½ of U.S.	Minimal
Eastern hognose snake Heterodon platyrhinos	Sandy woods and open areas	Statewide, except north-west	Common	Eastern ½ of U.S.	Minimal
Prairie ringneck snake Diadophis punctatus	Rocky open woods	Mostly statewide	Common	South-central	Minimal
Smooth green snake Opheodrys vernalis	Moist grasslands	Statewide	Common	North-east and north-central	Minimal
Eastern yellow-bellied racer Coluber constrictor	Fields, brush, open woods	Statewide	Common	Plains (this subspecies)	Minimal

TABLE C-4 (cont.)

Species	Habitat	Range in state	Estimated Abundance in state	Range in U.S.	Estimated Project Impact
Bullsnake Pituophis melanoleucus	Grasslands	Mostly statewide	Common	Plains	Minimal
Fox snake Elaphe vulpina	Open moist grasslands and woods	Statewide	Common	North-central	Minimal
Black rat snake Elaphe obsoleta	Wide range of open to wooded	South-east	Common	Central and east	Minimal
Red milk snake Lampropeltis triangulum	Open agricultural land and woodlands	Mostly statewide	Common	Central and east	Minimal
Prairie kingsnake Lampropeltis calligaster	Grasslands	Southern	Common	South-east	Minimal
Speckled kingsnake Lampropeltis getulus	River and stream valleys, grasslands	Southern	Rare	Southern	Local population depression
Eastern massasauga Sistrurus catenatus	Wet grasslands and marshes, wet woods	Southern	Rare	East-central to Texas	Local population depression
Timber rattlesnake Crotalus horridus	Second-growth woods and gallery forest	South-east	Occasional	South-east and south-central	Minimal

Sources: Conant, R. 1975. A field guide to the reptiles and amphibians of eastern and central North America. 2nd ed. Boston, Houghton Mifflin.

Menzel, B. W. 1975. Course manual for zoology 306, herpetology. Iowa State University.

APPENDIX D

AIR QUALITY AND METEOROLOGICAL DATA

APPENDIX D

AIR QUALITY AND METEOROLOGICAL DATA

Methodology

Pollutant Monitoring. A monitoring program was conducted at the Ottumwa Generating Station site. Particulate matter, sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) were measured. These pollutants are currently limited by federal and state regulations.

Following EPA statistical guidelines, measurements of pollutants were conducted in such a manner as to be representative of at least 75 per cent of all possible hours during a given year. Since June 2, 1975, that representation has been achieved by sampling every sixth day for 24 consecutive hours.

The scientists at Langston Laboratories, Inc. who conducted the monitoring program, used procedures described in the Federal Register, Standard Reference Methods of the Air Pollution Control Office (APCO) and methods recommended by the Intersociety Committee.

Samplers were calibrated in the laboratory prior to installation and then routinely in the field at a frequency which was dependent upon use and level of pollutants. About every 1000 hours of operation, the samplers were rebuilt to insure their operation during sampling periods.

General Metal Works High Volume Samplers were used to monitor total suspended particulate matter and Research Appliance Company (RAC) Gas Bubbler Trains were used to monitor SO_2 and NO_2 concentrations.

High volume samplers, which are installed at the site at the beginning of each sampling period, obtain an integrated quantity of total suspended particulate matter. Air is drawn into a covered housing and through a filter by means of a high flow rate motor blower. The filter allows suspended particles having diameters of less than 100 mm to pass to the filter surface. The mass concentration of suspended particulates in the ambient air ($\mu g/m^3$) is computed by measuring the mass of collected particulates and the volume of air sampled.

The RAC gas bubbler train samples a stream of air and absorbs SO_2 and NO_2. The bubbler system is contained in a constant temperature oven and in series with calibrated orifices and a constant flow sampling pump.

A field scientist manually initiated and terminated sampling. This procedure assured that each sampling period was performed on time without error. In the field, a preweighed glass fiber filter paper was installed on the Hi-Vol sampler, the RAC bubblers prepared, the SO_2 and NO_2 trains set up, and sampling initiated. Concurrently, meteorological data were collected. After 24 hours, sampling was terminated, the filter paper from the Hi-Vol stored, and the RAC train prepared for transport to the laboratory. After the RAC train arrived at the laboratory, the solutions in the train were analyzed immediately for SO_2 and NO_2.

Nitrogen dioxide was collected by bubbling air through a sodium hydroxide-sodium arsenite solution in fritted glass bubblers to form a stable solution of sodium nitrite. The nitrite ion produced during sampling was determined colorimetrically by reacting the exposed absorbing reagent with H_2O_2, phosphoric acid, sulfanilamide, and N-1-naphthylethyldiamine dihydrochloride.

Sulfur dioxide was absorbed from air in a solution of 0.04 M potassium tetrachloromercurate. The resulting dichlorosulfitomercurate complex was reacted with pararosanaline and formaldehyde to form intensely colored (red-purple) pararosanaline methyl sulfonic acid. The absorbency of the solution was measured spectrophotometrically.

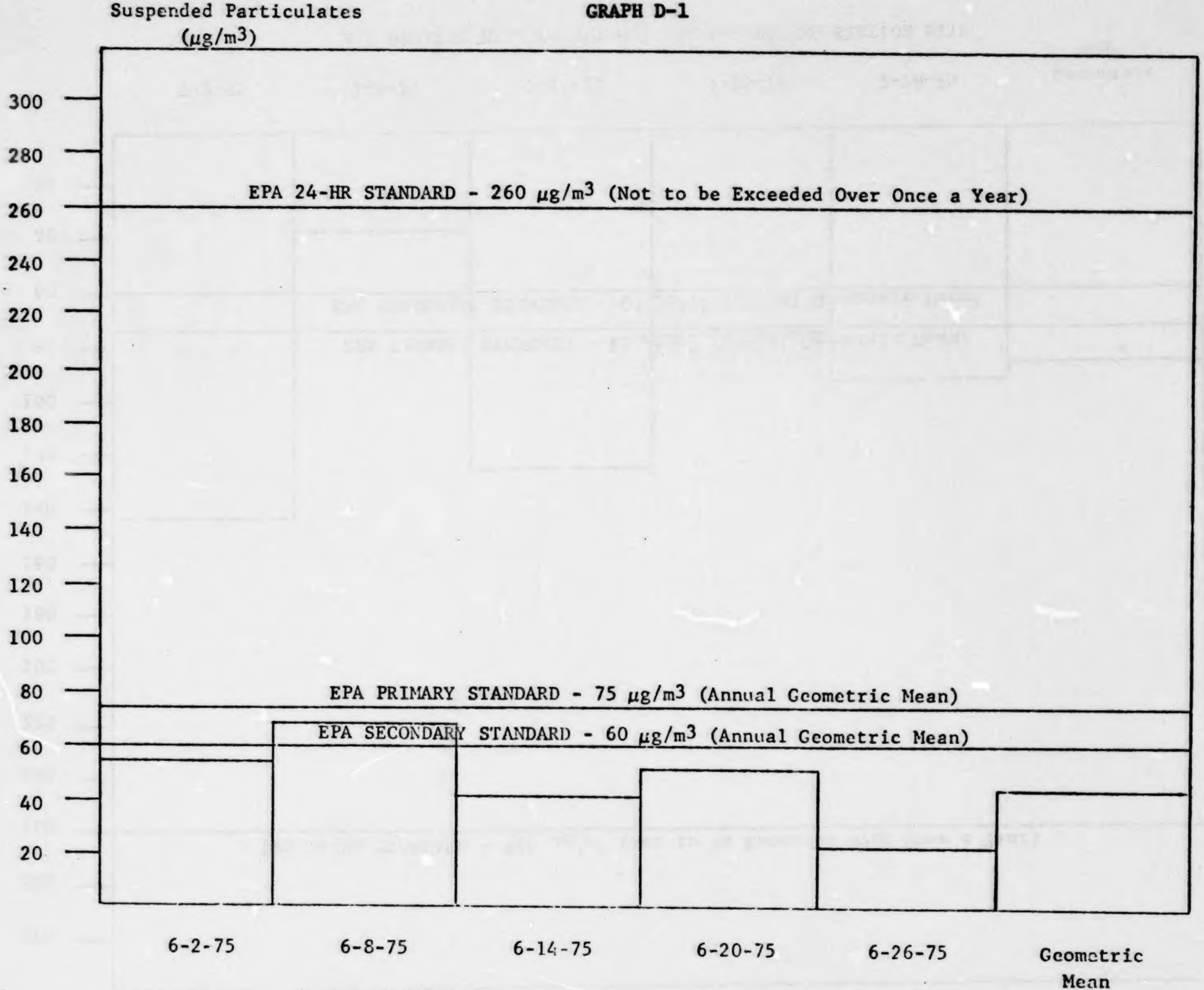
Since RAC's sampling train can handle as many as five separate bubblers at one time, the collection of SO_2 and NO_2 samples and the determination of the concentrations of these two parameters was run in duplicate. This duplicate effort was performed as a safeguard against any possible sampling error or equipment malfunction.

Meteorological Monitoring. Meteorological parameters that were determined were as follows: wind direction; wind velocity; temperature; rainfall; barometric pressure; relative humidity; and cloud cover. These climatic conditions were monitored to aid the scientists at Langston Laboratories in reporting the total suspended particulate, NO_2, and SO_2 concentrations under standard conditions (25 C and 760 mm of Hg), to facilitate the interpretation of the variations in concentration for the individual air pollutants, and to enable comparisons of the data now being generated with future ambient air quality data for the area.

The meteorological equipment that was used on this program was as follows: a Fisher Scientific continuous recording barometer, a Fisher Scientific continuous recording thermometer, a Fisher Scientific volumetric rain gage, and a Texas Electronics continuous recording wind direction and velocity system. Necessary equipment calibration was performed on a monthly basis.

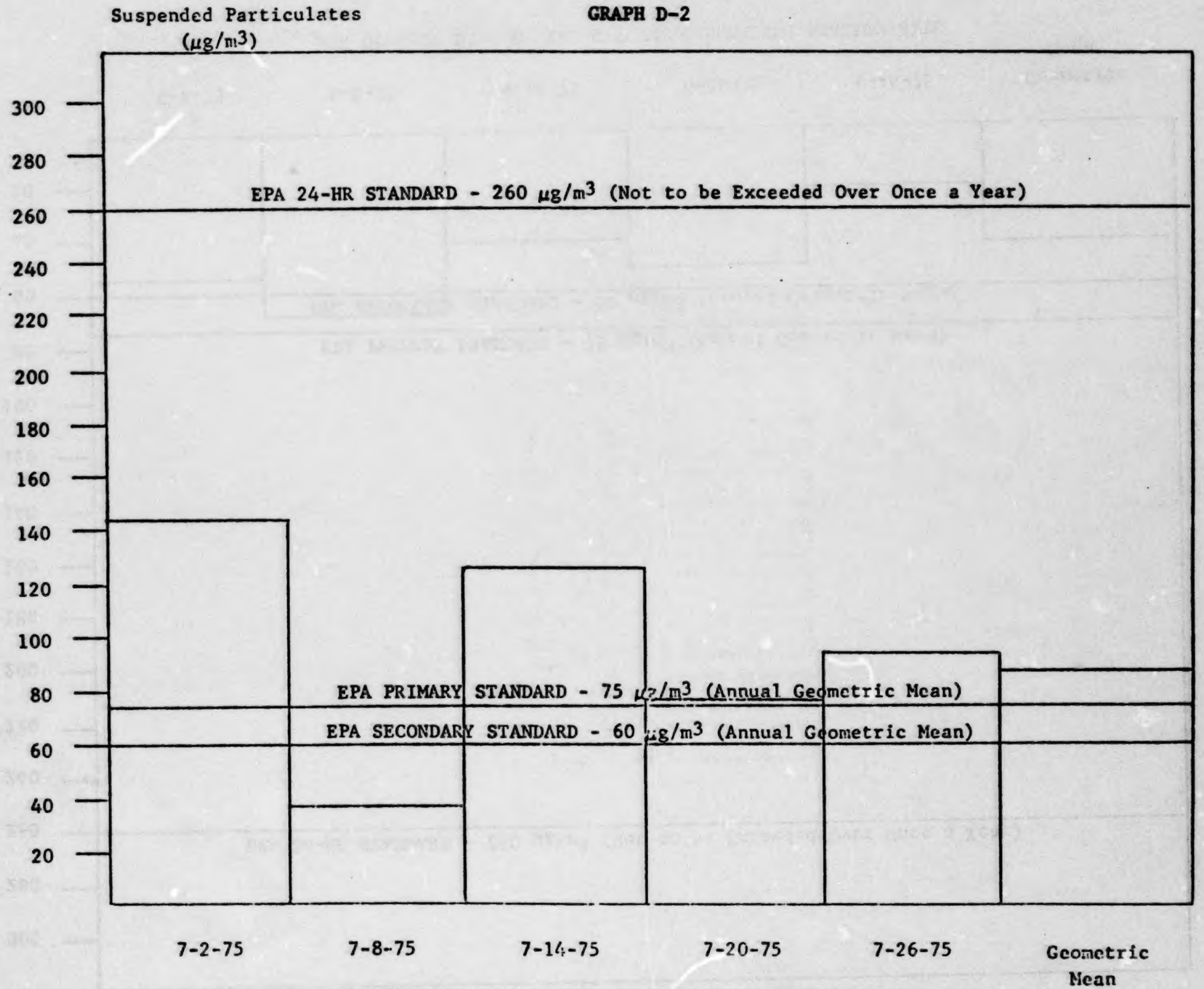
__Results__. Detailed ambient air qulaity data obtained during the monitoring program are illustrated in graph numbers D-1 through D-12. Data also are listed in Table D-1 and a summary of data is given in Table D-2.

GRAPH D-1



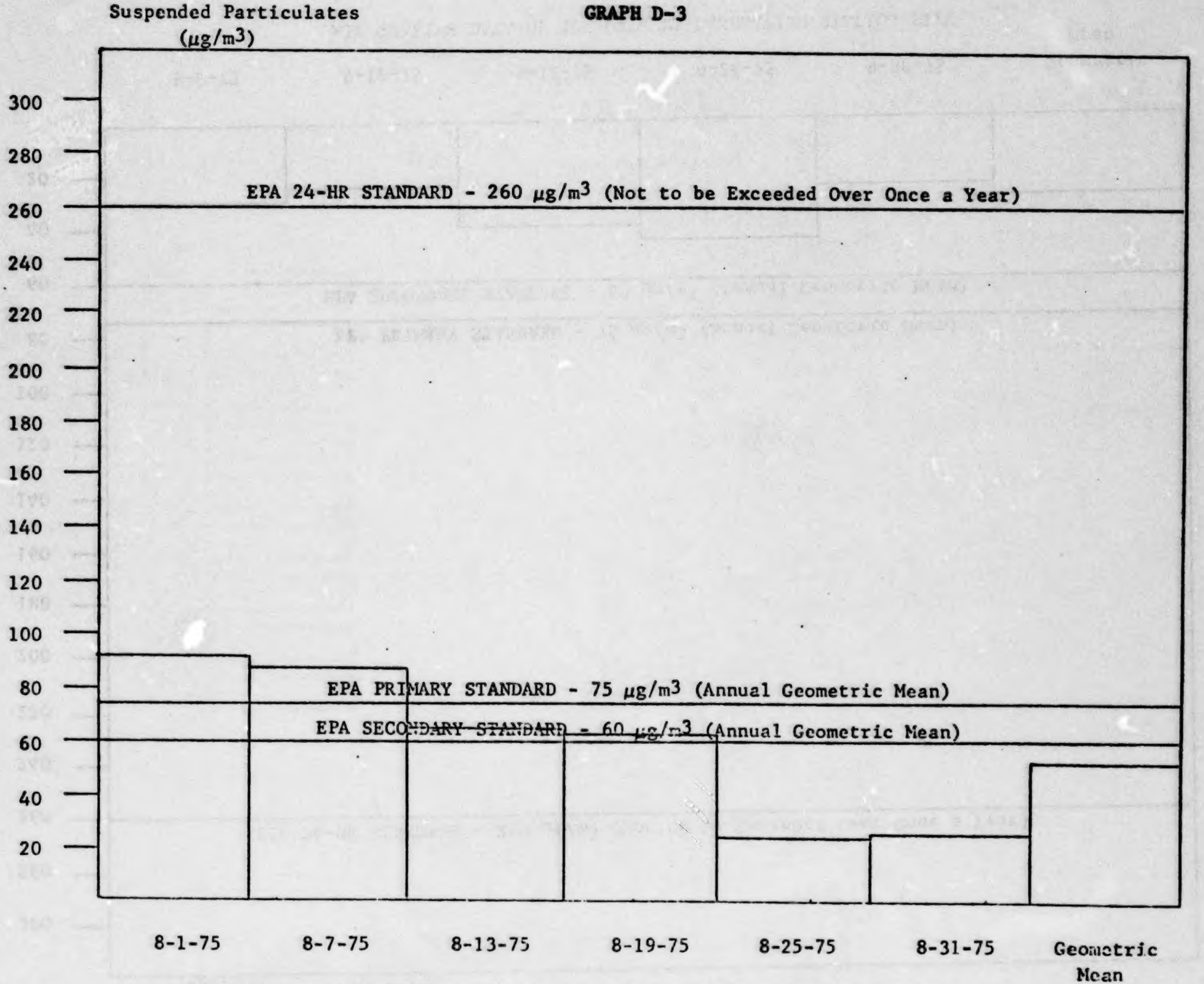
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-2



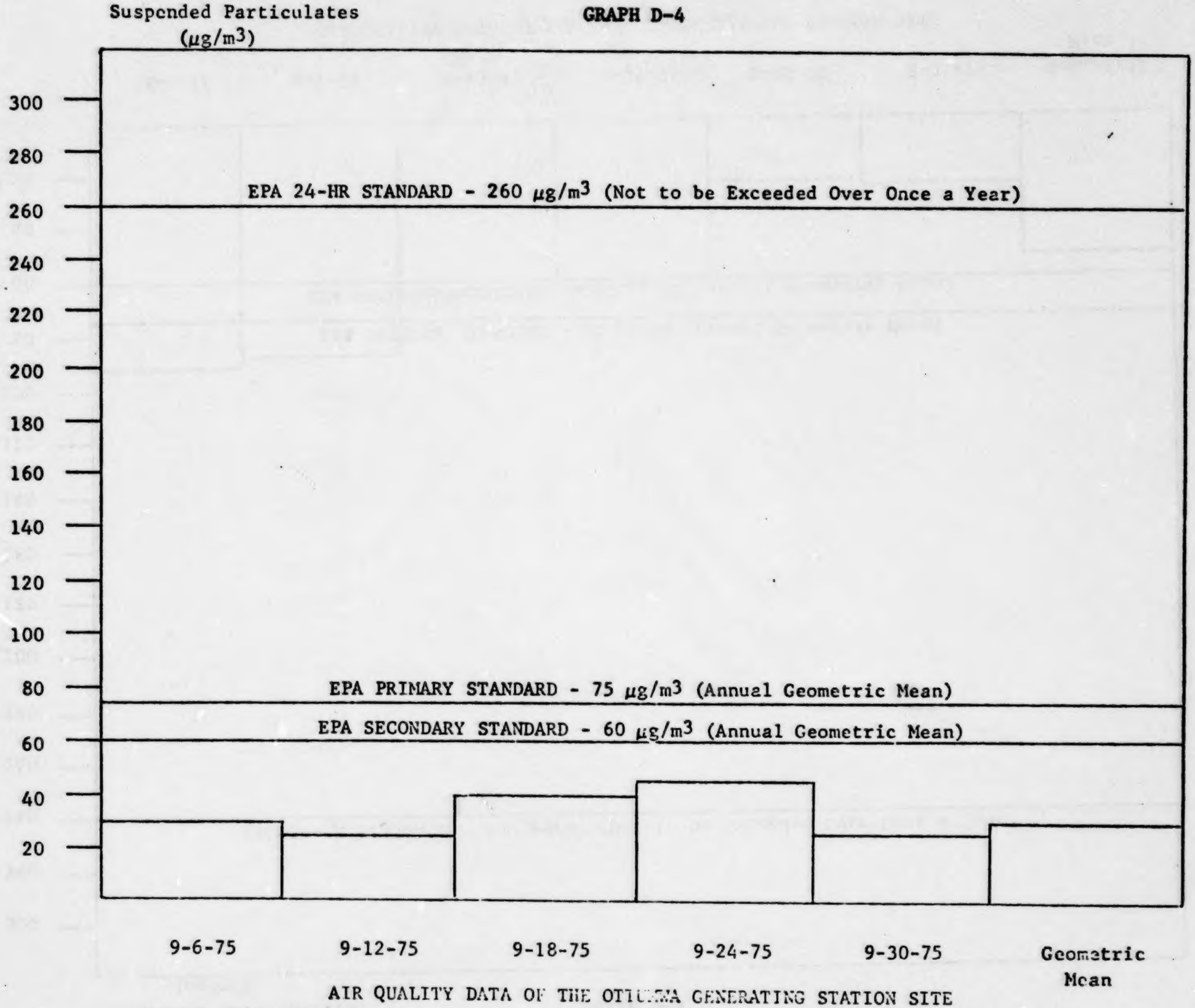
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-3



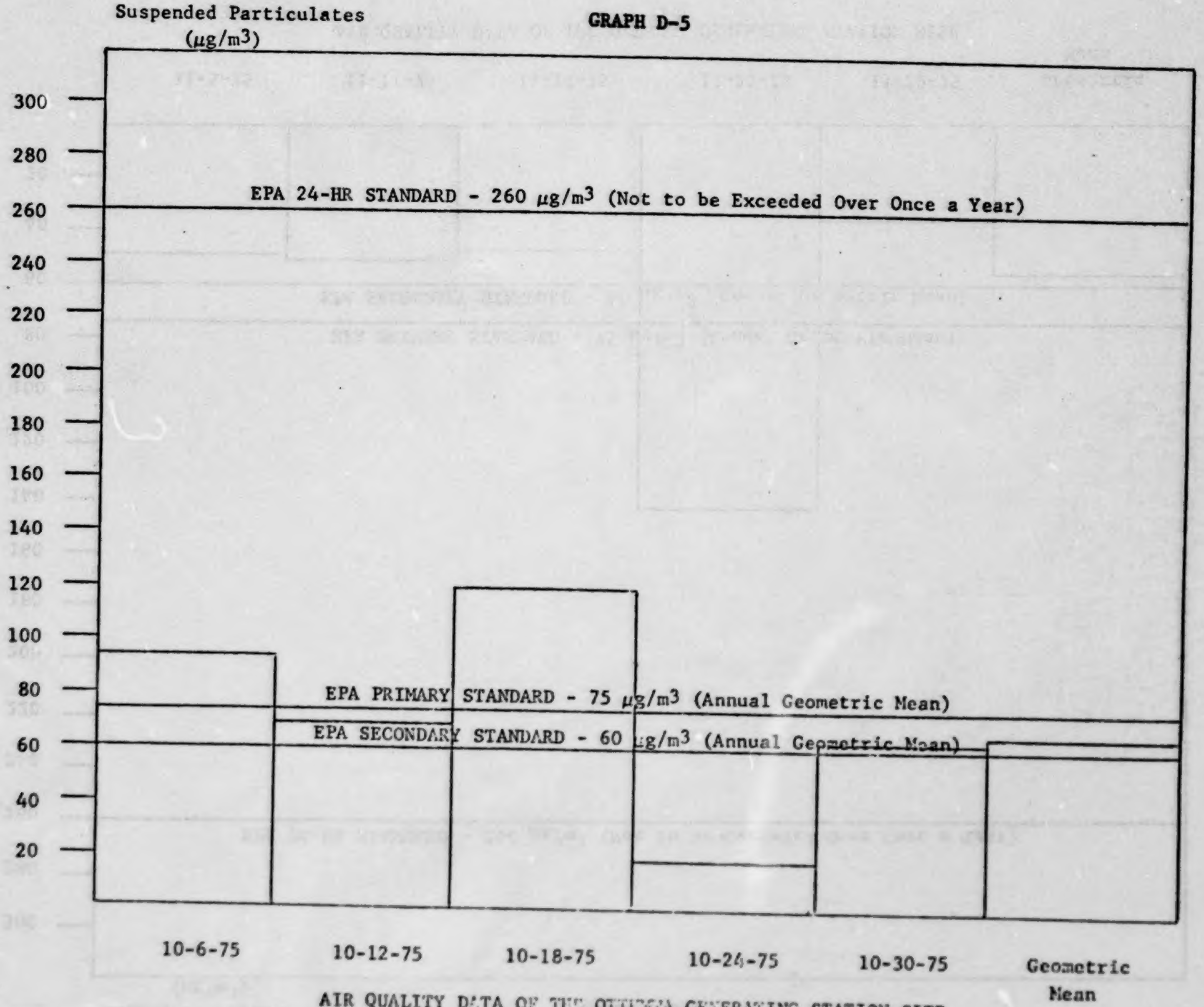
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-4



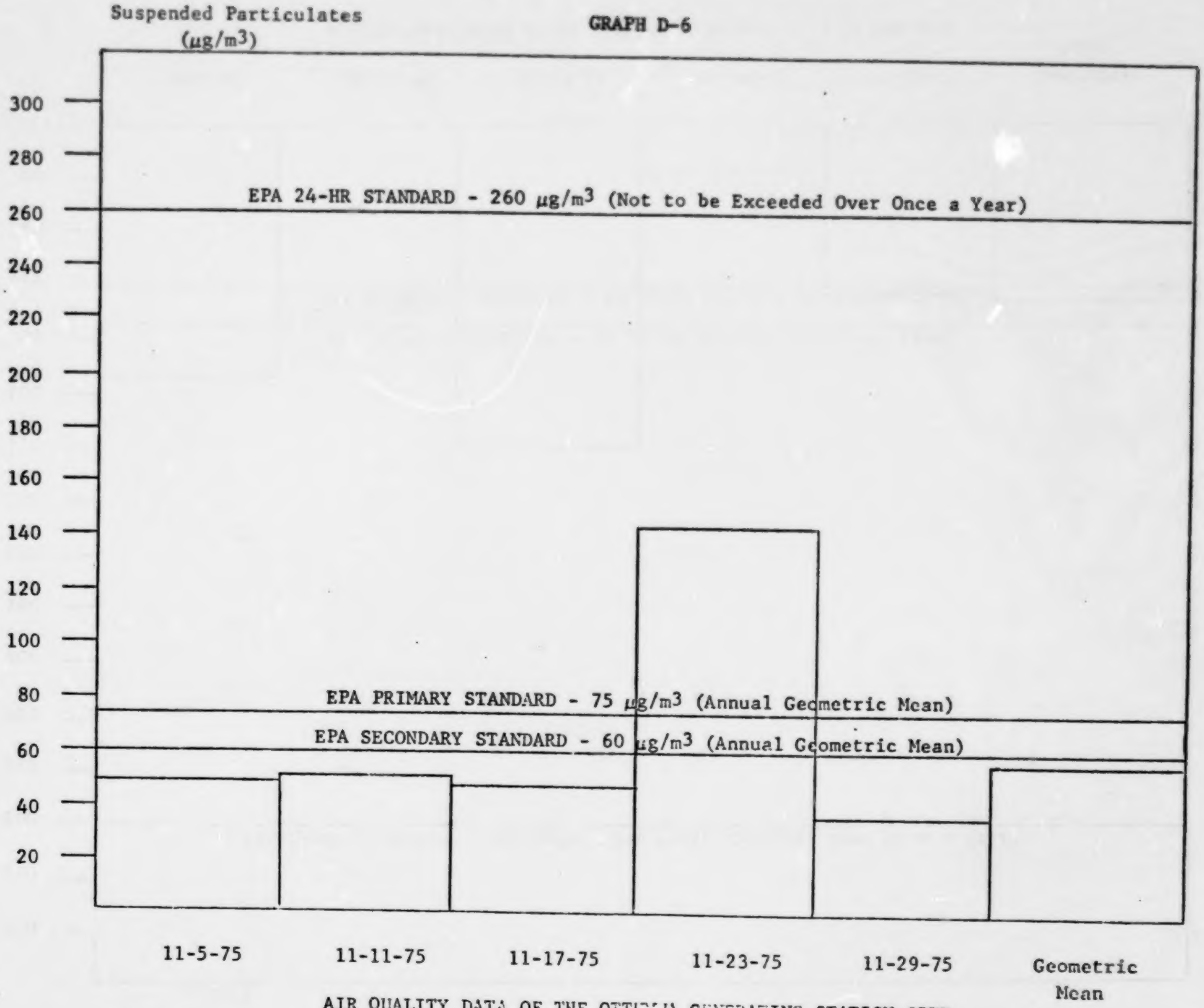
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-5



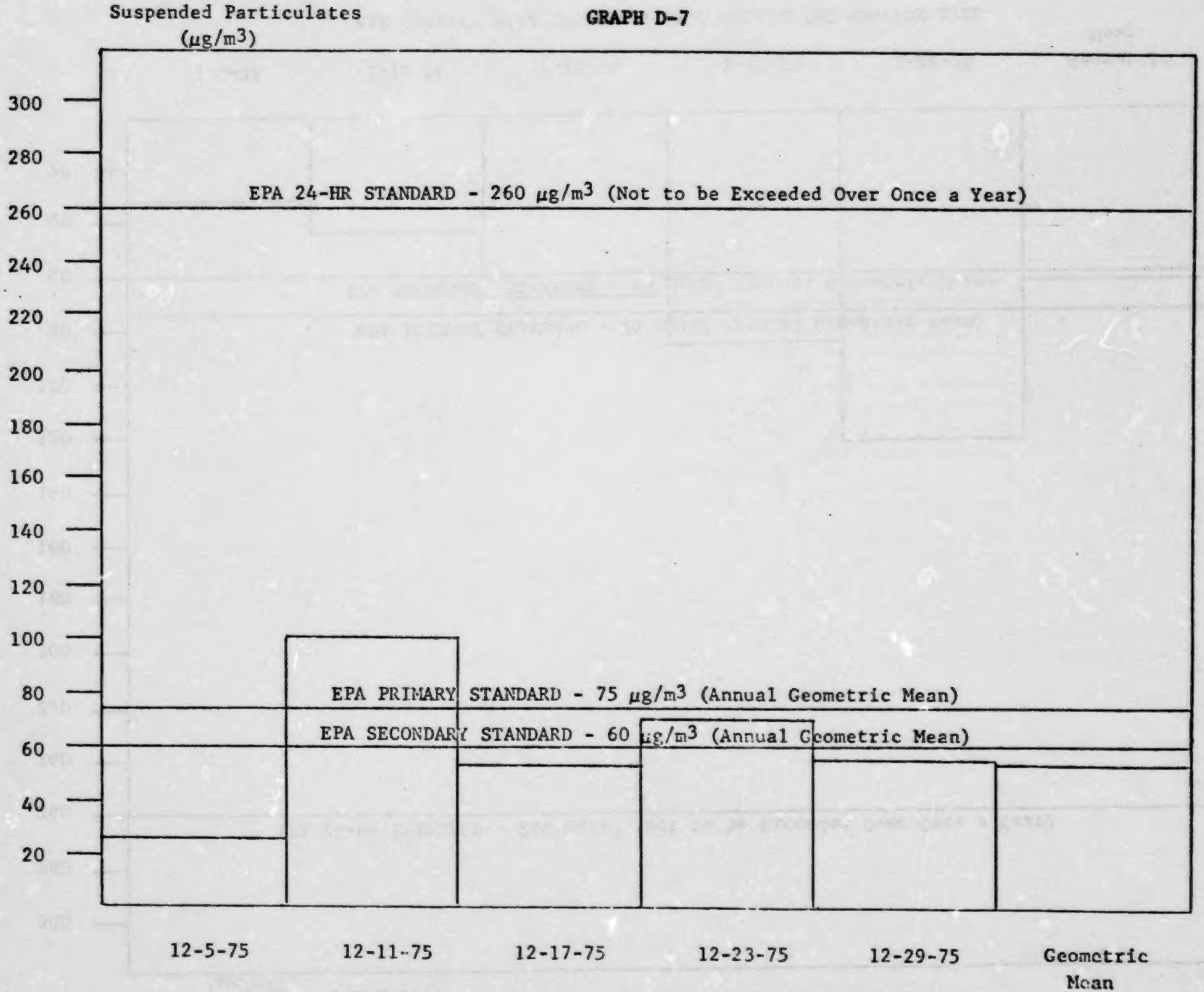
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-6



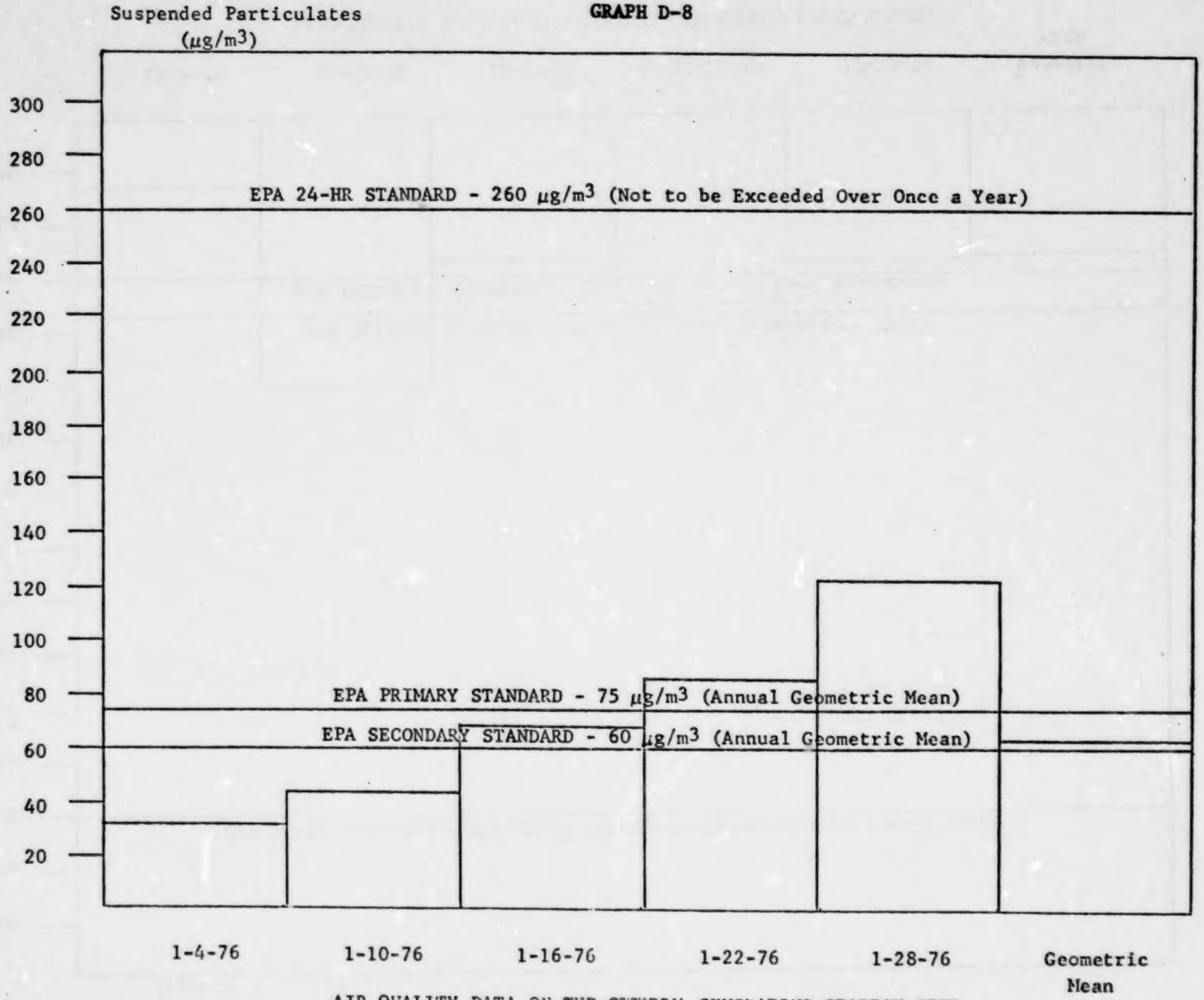
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-7



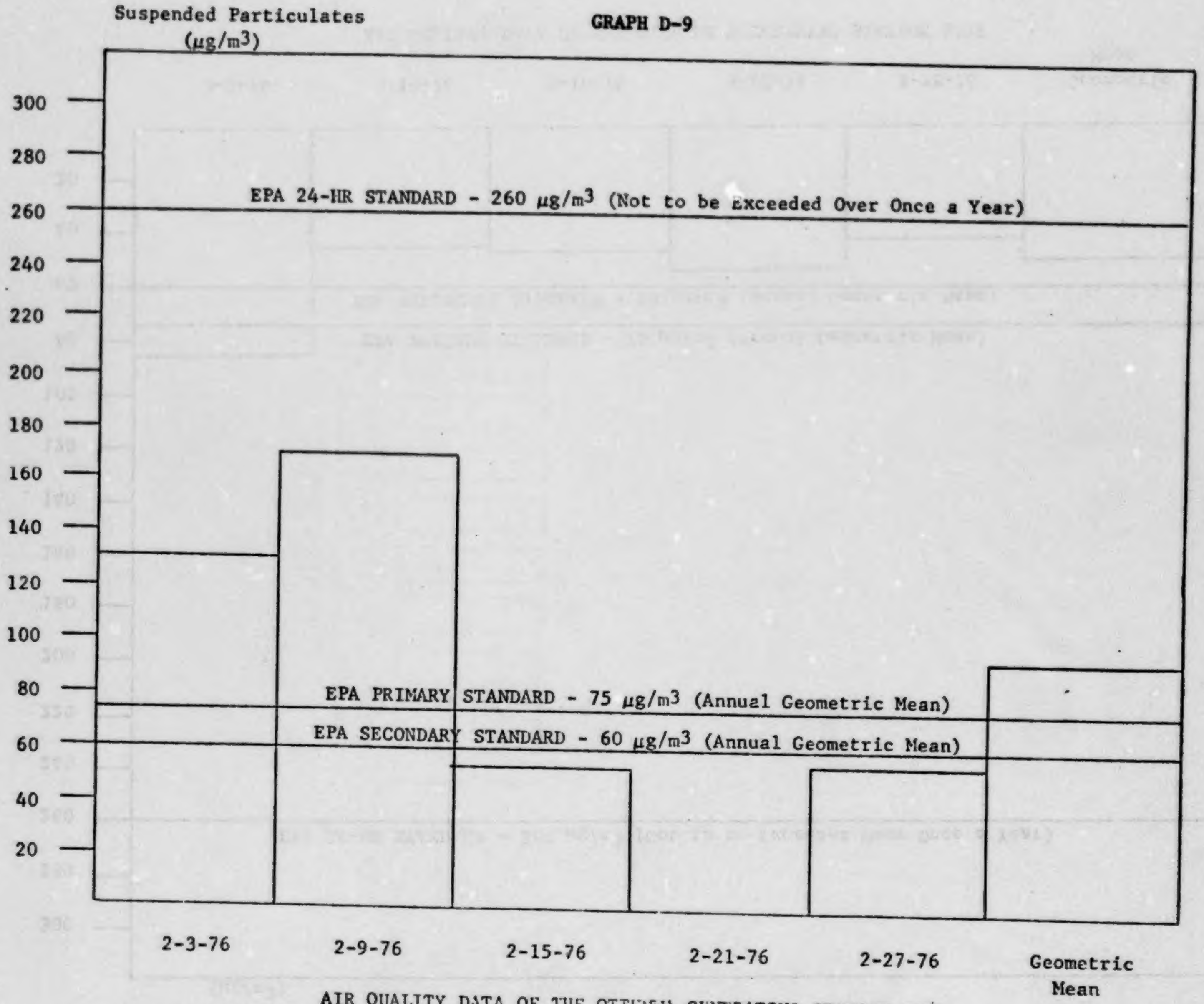
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-8



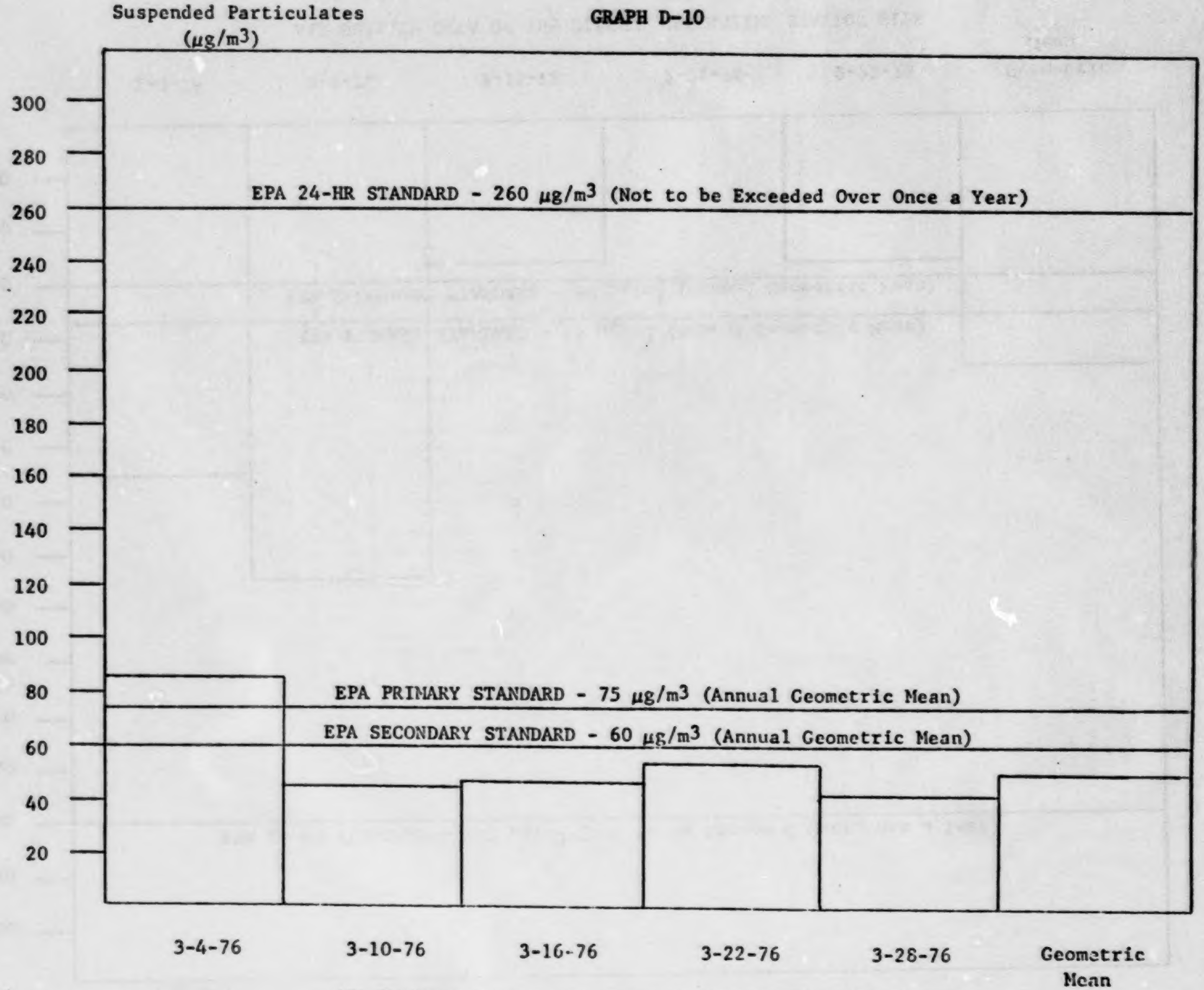
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-9



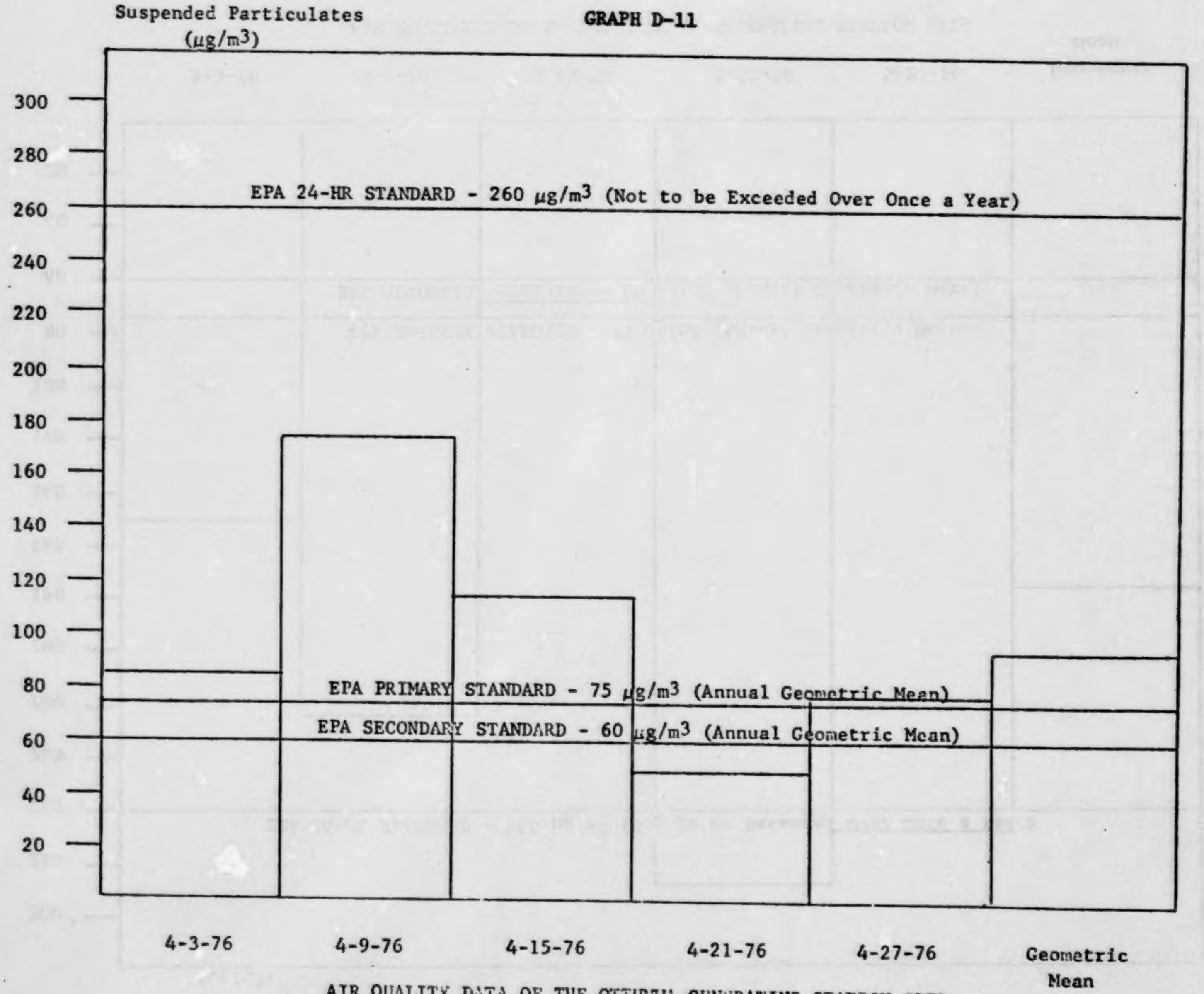
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-10



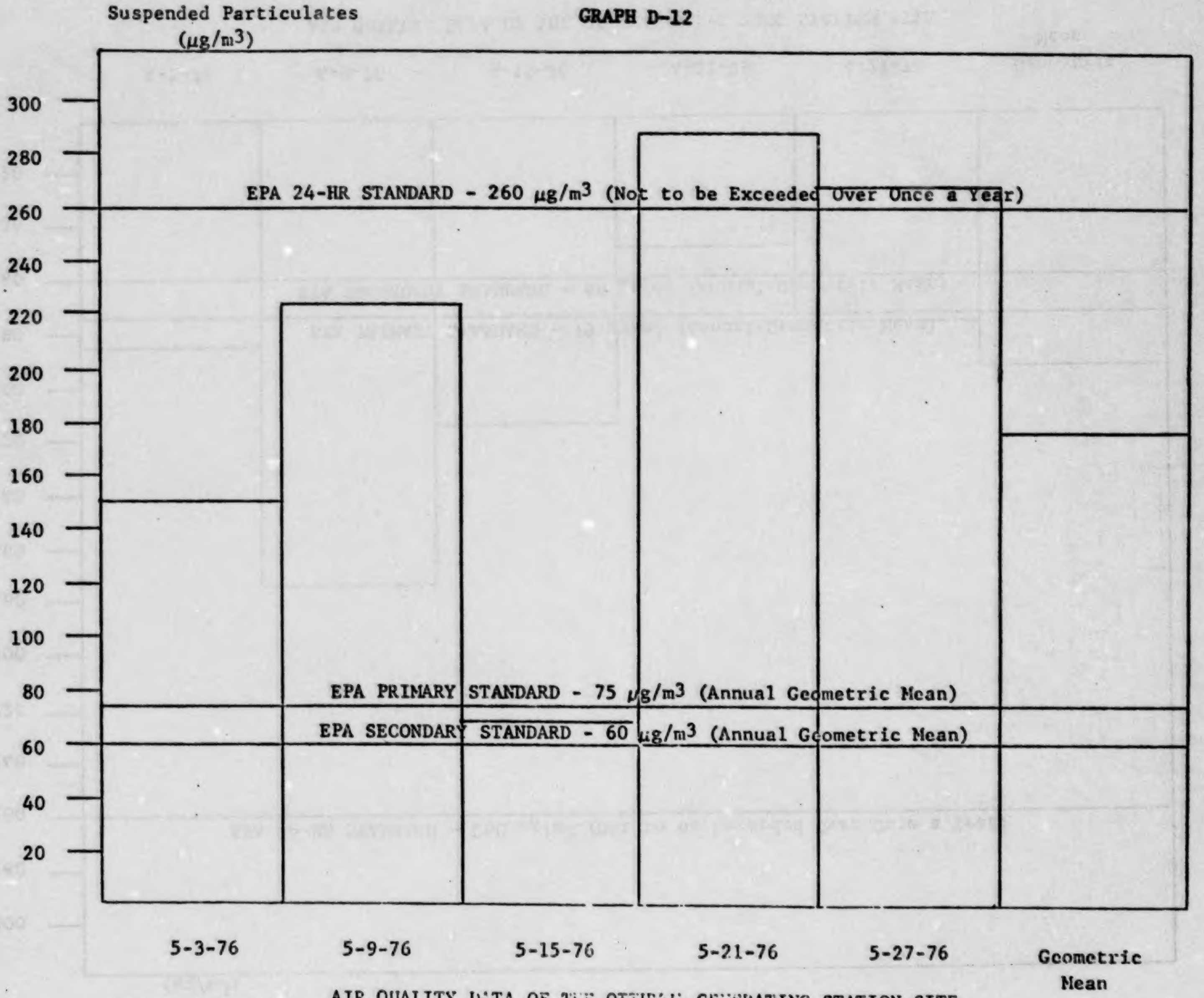
AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-11



AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

GRAPH D-12



AIR QUALITY DATA OF THE OTTUMWA GENERATING STATION SITE

TABLE D-1

AIR QUALITY DATA
OF THE OTTUMWA GENERATING STATION SITE

Date	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Suspended Particulates ($\mu g/m^3$)
6-2-75	25.2	3.5	54.4
6-8-75	10.1	BDL	67.9
6-14-75	20.1	5.4	41.4
6-20-75	14.8	BDL	52.3
6-26-75	67.5	3.6	24.5
Mean	27.5 (Arith)	3.3 (Arith)	45.5 (Geometric)
7-2-75	15.5	BDL	142.7
7-8-75	10.5	BDL	39.1
7-14-75	10.5	BDL	124.5
7-20-75	20.9	BDL	78.9
7-26-75	36.5	BDL	93.4
Mean	18.8 (Arith)	2 (Arith)	87.5 (Geometric)
8-1-75	BDL	BDL	91.6
8-7-75	BDL	BDL	85.8
8-13-75	BDL	BDL	65.8
8-19-75	BDL	BDL	63.2
8-25-75	BDL	BDL	25.1
8-31-75	BDL	BDL	25.6
Mean	6 (Arith)	2 (Arith)	52.5 (Geometric)
9-6-75	BDL	BDL	29.7
9-12-75	10.9	BDL	25.5
9-18-75	BDL	BDL	39.1
9-24-75	BDL	BDL	43.5
9-30-75	BDL	BDL	26.1
Mean	7.0 (Arith)	2 (Arith)	32.0 (Geometric)
10-6-75	BDL	BDL	95.8
10-12-75	8.4	BDL	69.0
10-18-75	BDL	BDL	120.2
10-24-75	BDL	BDL	20.0
10-30-75	BDL	BDL	61.8
Mean	6.5 (Arith)	2 (Arith)	62.9 (Geometric)

TABLE D-1 (Continued)

Date	NO_2 ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	Suspended Particulates ($\mu g/m^3$)
11-5-75	BDL	BDL	48.9
11-11-75	BDL	BDL	51.7
11-17-75	BDL	BDL	47.2
11-23-75	BDL	BDL	142.2
11-29-75	BDL	BDL	39.1
Mean	6 (Arith)	2 (Arith)	58.1 (Geometric)
12-5-75	BDL	BDL	26.2
12-11-75	BDL	22.3	100.8
12-17-75	BDL	10.5	55.3
12-23-75	BDL	BDL	69.6
12-29-75	BDL	22.1	57.0
Mean	6 (Arith)	11.8 (Arith)	56.6 (Geometric)
1-4-76	BDL	10.7	30.7
1-10-76	BDL	11.0	45.4
1-16-76	BDL	BDL	67.5
1-22-76	6.6	11.1	85.5
1-28-76	9.9	11.5	121.1
Mean	6.9 (Arith)	9.3 (Arith)	62.8 (Geometric)
2-3-76	BDL	11.1	129.4
2-9-76	BDL	10.0	171.8
2-15-76	BDL	8.7	55.7
2-21-76	---	---	---
2-27-76	BDL	11.6	57.5
Mean	6 (Arith)	10.3 (Arith)	91.9 (Geometric)
3-4-76	BDL	6.6	86.9
3-10-76	BDL	5.6	43.8
3-16-76	BDL	10.3	46.9
3-22-76	7.1	17.7	55.3
3-28-76	7.2	14.3	41.6
Mean	6.5 (Arith)	10.9 (Arith)	52.8 (Geometric)
4-3-76	BDL	17.4	84.5
4-9-76	9.1	BDL	174.0
4-15-76	BDL	BDL	115.7
4-21-76	BDL	BDL	50.7
4-27-76	15.9	BDL	77.8
Mean	8.6 (Arith)	5.1 (Arith)	92.3 (Geometric)

TABLE D-1 (Continued)

Date	NO_2 ($\mu g/m^3$)		SO_2 ($\mu g/m^3$)		Suspended Particulates ($\mu g/m^3$)	
5-3-76	10.9		BDL		149.0	
5-9-76	18.3		BDL		222.8	
5-15-76	13.2		BDL		68.7	
5-21-76	32.8		BDL		286.1	
5-27-76	25.9		BDL		267.0	
Mean	20.2	(Arith)	2	(Arith)	177.1	(Geometric)

BDL - Below Detection Limits

NOTE: The detectable limit will fluctuate because of changes in barometric pressure and temperature. The detectable limit for NO_2 is 6 $\mu g/m^3$ at standard temperature and pressure. The detectable limit for SO_2 is 2 $\mu g/m^3$ at standard temperature and pressure.

TABLE D-2

SUMMARY OF POLLUTANT RESULTS

Parameter	Minimum ($\mu g/m^3$)	Maximum ($\mu g/m^3$)	Mean ($\mu g/m^3$)	Samplings Exceeding 24 Hour Primary Standard	Samplings Exceeding 24 Hour Secondary Standard
NO_2	6 *	67.5	10.5 (arithmetic)	**	**
SO_2	2 *	22.3	5.1 (arithmetic)	0	**
Suspended Particulate Matter	20.0	286.1	65.4 (geometric)	2	5

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* Detection Limit

** Not Applicable

(NOTE: See Table D-3 for Summary of National Primary and Secondary Standards)

TABLE D-3

NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

	Annual Arithmetic Mean
NO_2	
Primary	100 $\mu g/m^3$
Secondary	100 $\mu g/m^3$

	24 Hour Maximum *	Annual Arithmetic Mean
SO_2		
Primary	365 $\mu g/m^3$	80 $\mu g/m^3$

	24 Hour Maximum *	Annual Geometric Mean
Suspended Particulate Matter		
Primary	260 $\mu g/m^3$	75 $\mu g/m^3$
Secondary	150 $\mu g/m^3$	60 $\mu g/m^3$

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* To be exceeded no more than once per year.

APPENDIX E

DISPERSION CALCULATIONS

APPENDIX E

DISPERSION CALCULATIONS AND WIND DATA

GROUND LEVEL CALCULATIONS

The one-hour ground level concentrations directly downwind from an elevated source are computed using the Gaussian distribution of the plume as the following.

$$C = \frac{Q}{\pi \sigma_y \sigma_z \bar{u}} \exp \left[\frac{-h^2}{2\sigma_z^2} \right]$$

where:

C = downwind concentration

Q = pollutant release rate

σ_y σ_z = crosswind and vertical plume standard deviations

$\bar{u}$ = mean wind speed at the height of the stack

h = effective stack height

The σ's (one-hour average) are calculated from the downwind distance, d, as follows.

Stability Condition	σ_y meters	σ_z meters
Very Unstable	$0.40\ d^{0.91}$	$0.40\ d^{0.91}$
Unstable	$0.36\ d^{0.86}$	$0.33\ d^{0.86}$
Slightly Unstable	$0.34\ d^{0.82}$	$0.275\ d^{0.82}$
Neutral	$0.32\ d^{0.78}$	$0.22\ d^{0.78}$
Slightly Stable	$0.315\ d^{0.745}$	$0.14\ d^{0.745}$
Stable	$0.31\ d^{0.71}$	$0.06\ d^{0.71}$

The wind speed u, is that occurring at the height of 33 feet; this is the height of the wind instrument in Burlington. For the actual computation, wind speed at the top of the stack $\bar{u}$ is computed as:

$$\bar{u} = u \left(\frac{H}{33}\right)^{0.5} \text{, stable conditions}$$

$$\bar{u} = u \left(\frac{H}{33}\right)^{0.25} \text{, unstable and neutral conditions}$$

Where H is the actual stack height in feet.

Plume rise is computed from:

$$\Delta h = 2 \left(\frac{F}{\bar{u}G}\right)^{0.33} \text{, stable condition}$$

$$\Delta h = 150 \left(\frac{F}{\bar{u}^3}\right) \text{, very unstable, unstable, and slightly unstable conditions}$$

Weighted averages are used to compute plume rise under neutral and slightly stable conditions.

$$F = \text{buoyancy flux} = g\, V_E \left[\frac{D_E}{2}\right]^2 \frac{\left[T_E - T_a\right]}{T_E}$$

$$G = \text{stability parameter} = \frac{g}{T_a} \frac{\Delta\theta}{\Delta z}$$

$\frac{\Delta\theta}{\Delta z}$ = 0.0180 C per meter

T_E, T_a = stack gas and ambient temperatures

V_E = stack gas exit velocity

D_E = chimney liner inside diameter

The effective stack height, h, is the sum of the actual stack height, H, and the plume rise, Δh.

The 3-hour concentration is computed from the one-hour concentration by the following equation.

$$\frac{C_t}{C} = \left(\frac{1}{t}\right)^r$$

in which

t = time in hours

r = varies with the dispersion conditions, as follows.

Dispersion conditions	r
Very unstable	0.65
Unstable	0.52
Slightly Unstable	0.52
Neutral	0.32
Slightly Stable	0.00
Stable	0.00

The 24-hour average is calculated from the formula.

$$\text{24-hr Average} = 1/24 \sum_i \left[T_i \, C_i \, \frac{8\sqrt{2}}{\sqrt{\pi}} \, \frac{\sigma_{yi}}{d}\right]$$

where:

T_i is the average duration in hours that a given stability condition is expected to occur.

C_i is the maximum SO_2 concentration (with respect to wind speed) that could occur during the i-th stability condition.

$\frac{8\sqrt{2}}{\sqrt{\pi}} \frac{\sigma_{yi}}{d}$ is a factor that relates the probability that the plume center line will be overhead to the probability that the plume will be somewhere in a 22-1/2 degree sector.

σ_{y_i} is the Gaussian plume width under the i-th stability condition.

The durations, T_i, are typical for a 24-hour day with 12 hours of nighttime (annual average). For a seasonal study, these would be slightly adjusted for the actual season period of nighttime.

A base assumption in this formula is that the wind blows continuously into the 22-1/2 degree sector under investigation during the 24-hour period.

The annual average is calculated using the formula:

$$\text{Annual Average} - (1/8760)\sum\sum_{ij}\left[t_{ij}\quad C_{ij}\quad \frac{8\sqrt{2}}{\sqrt{\pi}}\quad \frac{\sigma_{yi}}{d}\right]$$

Where the tensor C_{ij} is the downwind concentration for a given wind speed, and a given stability condition.

The tensor t_{ij} is the average duration in hours that a given stability condition is expected to occur for a given wind speed times the frequency this wind speed will be in the given 22-1/2 degree sector. The assumption is made that whenever the wind is within a specific angular sector, it is distributed uniformly.

The wind speed frequency for each sector was obtained from the 1967-1971 Seasonal and Annual Wind Distribution by Pasquill Stability Classes (STAR Program) for Burlington, Iowa.

APPENDIX F

ECONOMETRIC MODEL DESCRIPTION

APPENDIX F

ECONOMETRIC MODEL DESCRIPTION

PRIMARY AREA ECONOMETRIC MODEL

I. Introduction

In order to measure the socioeconomic impact of OGS in the Primary Area, it was necessary to develop a tool to facilitate the estimation of future levels of economic activity. The tool employed in this analysis was a simplified econometric model of the Primary Area which captures historical economic interrelationships that have existed among key economic variables during the 25-year study period, 1950 to 1974. A list of the economic variables involved in the model is shown in Table F-1. The data base used to develop this model was derived from referenced sources by pooling historical cross-section and time-series sample data for the three counties in the Primary Area. These historical relationships are combined into a 23-equation simulation model of the Primary Area economy. These equations are shown in Table F-2. An explanation of the quantitative relationships that were estimated by multiple linear regression is contained in a subsequent section.

Once the economic relationships (equations) have been specified, certain exogenous or predetermined variables (POP, BI, FY, T, TR, and SI) are input into the computerized model to begin the order of solution and derive the expected values for each variable.

II. 1981 Price Deflator

Some of the variables included in this model are monetary variables and, due to the effects of inflation, must be deflated (or inflated) to a common base before they can be aggregated or compared. This is accomplished through the use of a 1981 price deflator derived from the historical GNP deflator as found in Business Conditions Digest. The historical GNP deflator, 1950 to 1974, is given on a 1958 base (1958 = 100). This series is projected from 1975 to 1981 by time series regression of the historical data. The estimating equation for the deflator is:

$$\text{DEFL} = 280085.7 - 21175.78 + 122.1415(T^2) + 3.518348(T^3) + .41771268(T^4)$$

The projected 1981 deflator based on 1958 (208.55) is then used as a new base (1981 = 100) and a fraction representing each previous year 1950-1980, is derived. These factors can then be used to convert monetary variables expressed in current dollars to constant 1981 dollars.

III. Equations of the Model

A. Population Sector. A relationship to determine expected population was specified and estimated in the form shown in Table F-2. This stochastic equation specifies that, historically, population density (PDM) in the Primary Area was explained by lagged population density (PDM in each previous year), personal income (PY), and time (T). The change in Primary Area population density has historically been inversely related to the explanatory variables PY and T. This relationship serves as a test of the personal income projections and other projections used to derive personal income during the economic study period 1975-2010. Binary or "dummy" variables (D1, D2, and D3) are used to eliminate intercounty differences. The positive coefficient for logged population density (PDM) shows the accelerator effect on population due to a change in the previous year's density, in the absence of the personal income and time effect.

B. Labor Force and Employment Sector. Projected total labor force (TLF) levels were derived from the historical relationship shown in Section II of Table F-2. Total labor force and employment (EM) are divided by population (POP) so that the effects of county size are eliminated.

Projected employment in the Primary Area without OGS is derived from the historical relationship exhibited in Table F-2. This stochastic equation shows that employment can be determined from business conditions (BI), the total labor force, and time (T). There is almost a one-to-one relationship between changes in TLF and changes in EM. The Business Index has generally increased during the historical period while employment has generally decreased. In the absence of other effects, employment in the Primary Area is expected to correlate positively to time. The negative relation between BI and EM means that business activity in the Primary Area has been partially insulated from cyclical swings in the U.S. economy and can be expected to remain so for some time.

The equations, used to determine the unemployment rate (UR) and real wage rate (WR) are the identities found in Section I of Table F-2.

c. Income Sector. Personal Income (PY) projections are estimated from the identity shown in Section III of Table F-2. Transfer payments (TR) and personal contributions to social insurance (SI) are determined exogeneously. Wages and salaries (WS), and profit and proprietor income (PRY) however, are determined by the model.

Wages and salaries constitute a major portion of personal income and are projected from the historical relationship between wages and salaries, employment, and the business index; as shown in Section III of Table F-2. Wages and salaries are shown to be positively related to both employment (EM) and the business index (BI).

The stochastic equation for profit and proprietor income (PRY) shown in Section III of Table F-2 describes historical changes in the level of this variable. This relationship suggests that PRY is positively related to the business index (BI) and retail sales (RS).

Disposable income (DY) is estimated using the identity shown in the Income sector of Table F-2, which states that disposable income is personal income less taxes.

d. Agricultural Sector. Number of farms (NF) in the Primary Area was projected to the year 2010, based on its historical relationship with average value of farmland and buildings (AVLB), farm income (FY) and lagged number of farms (NF-1) as shown in Section IV of Table F-2. This equation suggests that NF is inversely related to average value of farmland and buildings (negative coefficient for AVLB in the Primary Area ignoring the effects of other variables).

Total land in farms (LF) was projected from its historical relationship with population (POP) and Time (T) using the estimating equation shown in Table F-2. This LF equation suggests that in the absence of the population effect, land in farms decreased by 997.5 acres per year but that population effects partially offset the decline.

Average size of farms is projected using the identity shown in Section IV of Table F-2.

The equation which describes the historical relationship of assessed value of farm land and buildings (VFLB) and is used to project expected values is presented in the agricultural sector of Table F-2. County dummy variables (D1, D2, and D3) were employed as indicators of land productivity and expectations for future economic conditions. The remainder of the equation suggests that VFLB is negatively related to population density (PDM) and positively related to time (T) in the Primary Area. Ignoring the effects of PDM and T the equation further suggests that VFLB is positively related to changes in non-farm earnings. Average value of farm land and buildings is calculated directly by dividing VFLB by land in farms (LF).

E. Business Activity Sector. Projected retail sales (RS) in the Primary Area were estimated from their historical relationship to disposable income (DY) as shown by the RS equation in Table F-2. After adjustments for county variations in retail sales, the RS relationship indicates that the marginal propensity to purchase from disposable income is approximately 0.18, implying that a one dollar increase in disposable income in the Primary Area will increase retail sales by $0.18.

Projected bank deposits (BD) were derived using the historical relationship as shown in Section V of Table F-2. As expected, the equation indicates that bank deposits are positively correlated to DY and BI.

F. Real Estate Sector. The first equation in Section VI of Table F-2 describes the historical effect of real estate valuation (REV) and time (T) on total assessed property valuation (APV). This equation indicates that the total value of real estate and personal property is positively related to both REV and T. Values of the dummy variables eliminate the effects of size variances among the Primary Area counties.

Projected real estate valuation per square mile (REM) is estimated based on its historical relationship with lagged REM (REM-1), population density (PDM), and time (T) as indicated by the equation in the real estate sector of Table F-2. The market value of real estate is determined by the demand of all potential buyers and the supply of all potential sellers. The supply of real estate is very inelastic. The demand schedule of all buyers depends upon the prices of real estate, the expected population density, income, real estate characteristics, and expected future economic conditions. The dummy variables, one for each county, are employed in the above stochastic equation as indicators of the nonquantifiable variables such as real estate characteristics, tastes of buyers, and expectations for future economic conditions. The remaining variables explicitly determine the direction and magnitude of change in REM which can be quantified. The above equation suggests the REM is positively related to lagged REM and time in the Primary Area but, ignoring these two variables, suggests that REM has been inversely related to population density (PDM).

The two components of total assessed property valuation, real estate valuation and personal and public service valuation, are estimated using the identities shown in Section VI of Table F-2.

G. Government Revenues. The historical relationship between retail sales tax, retail sales, and time is represented by the first equation in Section VII of Table F-2. The coefficient of retail sales (RS) suggests that, ignoring the effects of intercounty differences and time, a one dollar increase in retail sales will produce a \$.036 increase in sales tax revenues. The time variable (T) is an indicator of changes in the structure of sales taxes and the composition of retail sales.

Projected levels of federal income taxes (FIT) are estimated from the second equation in Section VII of Table F-2. The explanatory variable for FIT, personal income (PY) is positively related to FIT and its coefficient suggests that the net marginal rate of federal income taxation in the Primary Area is 3.96 per cent, after adjustments for intercounty differences.

State personal income tax revenues (SPT) from the Primary Area are also projected from their relationship to personal income (PY). The coefficient of PY shown in Table F-2 has the same interpretation as for FIT, i.e. the net marginal rate of state income taxation.

Table F-1

LIST OF ECONOMIC VARIABLES

APV	Total Assessed Property Valuation ($1000)
ASF	Average Size of Farms: Total Acres divided by the number of farms
AVLB	Average Value of Land and Buildings per farm acre
BD	Bank Deposits
BI	Index of General Business (12 leading indicators prior to reverse trend adjustment)
D_1	Dummy for Monroe County
D_2	Dummy for Mahaska County
D_3	Dummy for Wapello County
DY	Disposable Income ($1000)
EM	Employment
FIT	Federal Income Tax ($1000)
FY	Farm Income
LF	Land in Farms: Total number of acres listed as agricultural land
NF	Number of Farms
PDM	Population Density per square mile
POP	Population
PRY	Proprietor, Property and Profit Income ($1000)
PSV	Personal Property and Public Service Valuation
PY	Personal Income ($1000)
REV	Real Estate Valuation
REM	Real Eatate Value per square mile ($8000)
RS	Retail Sales
SPT	State Personal Tax, except federal income tax ($1000)
ST	Sales Tax ($1000)
T	Time
TLF	Total Labor Force
UR	Unemployment Rate
VFLB	Value of Farm Land and Buildings ($1000)
WR	Real Wage Rate
WS	Wage and Salary Income
WS-1	Lagged WS

TABLE F-2

EQUATIONS OF THE PRIMARY AREA ECONOMETRIC MODEL

I. POPULATION SECTOR

$$\mathrm{LOG(PDM)} = 12.2118\ D_1 + .0968\ D_2 + .2585\ D_3 + .612598[\mathrm{LOG(PDM)}{-1}] - .003694\ \mathrm{LOG\ (PY)} - 3.543753\ \mathrm{LOG\ (T)}$$

II. LABOR FORCE AND EMPLOYMENT SECTOR

$$\frac{\mathrm{TLF}}{\mathrm{POP}} = .016054\ D_1 - .008625\ D_2 - .002253\ D_3 + 1.01477068\ \frac{\mathrm{EM}}{\mathrm{POP}}$$

$$\mathrm{EM} = -3964.5\ D_1 + 79.0\ D_2 - 244.1\ D_3 + .969690\ \mathrm{TLF} - .267611\ \mathrm{BI} + 1.981279\ \mathrm{T}$$

$$\mathrm{UR} = (\mathrm{TLF} - \mathrm{EM})/\mathrm{TLF}$$

$$\mathrm{WR} = \mathrm{WS}/(\mathrm{EM} \times 2000)$$

III. INCOME SECTOR

$$\mathrm{PY} = \mathrm{WS} + \mathrm{PRY} + \mathrm{TR} - \mathrm{SI}$$

$$\mathrm{WS} = -35995\ D_1 + 23840\ D_2 + 121849\ D_3 + 1.110244\ \mathrm{EM} + 432.153857\ \mathrm{BI}$$

$$\mathrm{PRY} = -21687\ D_1 + 2647\ D_2 - 17569\ D_3 + 210.842717\ \mathrm{BI} + .718049\ \mathrm{RS}$$

$$\mathrm{DY} = \mathrm{PY} - \mathrm{FIT} - \mathrm{SPT}$$

IV. AGRICULTURAL SECTOR

$$\mathrm{NF} = 84.4\ D_1 + 157.1\ D_2 + 49.6\ D_3 + .95035\ \mathrm{NF}_{-1} - .02634\ \mathrm{AVLB} - .00918\ \mathrm{FY}$$

$$\mathrm{LF} = 2211763\ D_1 + 96818\ D_2 - 16547\ D_3 + .392649\ \mathrm{POP} - 997.552751\ \mathrm{T}$$

$$\mathrm{ASF} = \mathrm{LF}/\mathrm{NF}$$

$$\mathrm{VFLB} = -619480\ D_1 + 15944\ D_2 + 8432\ D_3 - 164.775233\ \mathrm{PDM} + .066531\ \mathrm{WS}_{-1} + 321.138136\ \mathrm{T}$$

$$\mathrm{AVLB} = \mathrm{VFLB}/\mathrm{NF}$$

TABLE F-2 (continued)

EQUATIONS OF THE PRIMARY AREA EXONOMETRIC MODEL

V. BUSINESS ACTIVITY SECTOR

$$RS = 18455.7\ D_1 + 37751.7\ D_2 + 66658.0\ D_3 + .183512\ DY$$

$$BD = -156382 + .092343\ DY + 3159.529302\ BI$$

VI. REAL ESTATE SECTOR

$$APV = -321911\ D_1 + 8567\ D_2 + 14381\ D_3 + .861446\ REV + 168.84053\ T$$

$$\begin{aligned} LOG(REM) = {} & -14.5399\ D_1 + .034522\ D_2 + .062539\ D_3 + .946361\ LOG(REM_{-1}) \\ & - .044919\ LOG(PDM) + 4.459939\ LOG\ (T) \end{aligned}$$

$$REV = REM \times \text{Square miles}$$

$$PSV = APV - REV$$

VII. GOVERNMENT REVENUES

$$ST = -48588\ D_1 - 793\ D_2 - 1125\ D_3 + .036434\ RS + 24.547334\ T$$

$$FIT = 1060\ D_1 + 2708\ D_2 + 7984\ D_3 + .039658\ PY$$

$$SPT = -362\ D_1 - 819.6\ D_2 - 2121\ D_3 + .021767\ PY$$

VIII. EXOGENOUS VARIABLES

(POP)	"Without OGS" Population
(TR)	Transfer Payments
(SI)	Personal Contribtuions to Social Insurance
(FY)	Farm Income
(BI)	Business Index
(T)	Time

APPENDIX G

ECONOMIC DATA

LIST OF TABLES

G-1 Selected Statistics for the State of Iowa

G-2 Primary Area Employment by Economic Sector, 1950-1970

G-3 Public Facilities and Services - Ottumwa, Iowa

G-4 Primary Area - Projected Economic Activity with OGS

TABLE G-1

SELECTED STATISTICS FOR THE STATE OF IOWA

	Population (a)			Income per Capita		Personal Income Tax(c)	
	State Total #	Primary Area % Total State	State Density #/mi²	State Total 1981$	Primary Area % Total State	State Total 1981$(000)	Primary Area Total State %
1950	2,625,000	3.4	46.6	3,763	66.4	41,131	4.2
1955	2,712,000	3.0	48.2	3,618	87.5	50,374	3.1
1960	2,758,000	2.9	49.0	3,994	94.5	73,843	2.6
1965	2,758,000	2.9	49.0	5,171	91.2	105,603	2.8
1970	2,824,000	2.6	50.2	5,781	95.8	231,554	1.7
1974	2,890,000	2.6	51.3	5,967(b)	97.8	447,159	2.1

(a) U.S. Bureau of Census, Current Population Projections, Series P-25

(b) Values obtained from U.S. Commerce Department Survey of Current Business, (Value shown for 1974 is a 1973 preliminary from the April 1974 issue)

(c) State of Iowa, Department of Revenue, Individual Income Tax, Annual Statistical Report, 1950-1974, Research and Statistics Division

TABLE G-2

PRIMARY AREA EMPLOYMENT BY ECONOMIC SECTOR
1950 - 1970(a)

Sector	1950	Per cent of Total State	1960	Per cent of Total State	1970	Per cent of Total State
Agriculture	7,074	23.1	4,650	16.6	2,694	10.2
Mining	469	1.5	209	0.7	73	0.3
Construction	1,455	4.8	1,526	5.4	1,174	4.4
Manufacturing	6,787	22.2	6,935	24.7	6,521	24.7
Finance	566	1.9	754	2.7	790	3.0
Services	4,930	16.1	5,668	20.2	6,952	26.3
Public Administration	866	2.8	775	2.8	874	3.3
Transportation	2,797	9.1	2,169	7.7	1,576	6.0
Wholesale Trade	1,040	3.4	943	3.4	811	3.1
Retail Trade	4,615	15.1	4,446	15.8	4,979	18.8
Total	30,599		28,075		26,444	

(a) Source: U.S. Census of Population, 1950 - 1970, Bureau of Census, 1970

TABLE G-3

PUBLIC FACILITIES AND SERVICES
OTTUMWA, IOWA

Rail Service	Burlington Northern, Milwaukee Road, Rock Island, Norfolk and Western
Air Service	Ozark
Bus Service	Continental Trailways, Greyhound, Missouri Transit (Also local intra-city line)
Truck Service	62 common carriers serve city through 12 terminals
Taxi	2; 5 cabs
Utilities	Electric, gas, water, wastewater, telephone
Banks	3
Savings and Loan	2
Hotels and Motels	570 rooms
Civic Clubs and Service Organizations	24
Churches	67
Schools	
Public	20
Parochial	0
Teachers	379
Libraries	1; Approx. 110,000 volumes
Colleges	Ottumwa Heights, 2 year; Indian Hills Community College
Hospitals	2; 368 beds plus 3 nursing-convalescent homes
Health Clinics	4
Doctors	20 GP's, 5 Surgeons, 20 Specialists
Dentists	13

TABLE G-3 (continued)

PUBLIC FACILITIES AND SERVICES
OTTUMWA, IOWA

Recreational Facilities	11 parks, 5 swimming pools, 3 tennis courts, 2 golf courses (18 holes), 3 bowling alleys, 3 ice rinks, one roller rink, boating, fishing, hunting, spectator sports
Law Enforcement	32 police officers, 7 cars and 2 cycles
Fire Protection	41 full-time personnel, 2 fire stations

TABLE G-4

PRIMARY AREA
PROJECTED ECONOMIC ACTIVITY WITH OGS
(Direct and Indirect Impacts in Parentheses)

Year	Population No.	Population Density No./Sq Mi	Total Labor Force No.	Employment No.	Unemployment Rate per cent	Personal Income $1000
1975	76,774	53.2	31,222	29,849	4.4	464,412
1976	77,238(90)	53.5(0.1)	32,006(208)	30,620(208)	4.3(-0.1)	475,532(4,867)
1977	77,761(240)	53.9(0.2)	32,919(545)	31,520(545)	4.2(-0.1)	489,667(12,750)
1978	78,697(802)	54.5(0.6)	34,197(1,247)	32,785(1,247)	4.1(-0.2)	512,331(29,161)
1979	79,400(1,132)	55.0(0.8)	35,381(1,854)	33,956(1,854)	4.0(-0.3)	532,798(43,376)
1980	79,062(420)	54.8(0.3)	35,325(1,222)	33,887(1,222)	4.1(-0.1)	524,262(28,567)
1981	79,165(150)	54.8(0.1)	34,747(68)	33,296(68)	4.2	503,525(1,598)
1985	80,660(150)	55.9(0.1)	37,048(64)	35,545(64)	4.1	528,434(1,497)
1990	82,528(150)	57.2(0.2)	39,929(64)	38,362(64)	3.9	559,696(1,497)
1995	84,395(150)	58.4(0.1)	42,810(64)	41,178(64)	3.8	590,958(1,497)
2000	86,263(150)	59.7(0.1)	45,691(64)	43,994(64)	3.7	622,220(1,497)
2005	88,131(150)	61.0(0.1)	48,572(64)	46,810(64)	3.6	653,482(1,497)
2010	89,999(150)	62.3(0.1)	51,454(64)	49,627(64)	3.6	684,744(1,498)

TABLE G-4 (continued)

PRIMARY AREA
PROJECTED ECONOMIC ACTIVITY WITH OCS
(Direct and Indirect Impacts in Parentheses)

Year	Wages & Salaries $1000	Profit and Proprietor Income $1000	Disposable Income $1000	Transfer Payments $1000	Contributions To Social Insurance $1000	Real Wage Rate $/Hr
1975	243,826	175,285	426,041	61,888	16,597	4.08
1976	250,962(4,169)	177,894(698)	436,477(4,568)	63,947	17,272	4.10(.04)
1977	260,454(10,704)	181,153(2,046)	449,743(11,966)	66,006	17,946	4.13(.10)
1978	277,700(24,993)	185,186(4,168)	471,015(27,369)	68,065	18,621	4.24(.23)
1979	293,146(37,482)	188,823(5,894)	490,225(40,711)	70,124	19,295	4.32(.34)
1980	283,311(24,689)	188,738(3,898)	482,214(26,832)	72,183	19,970	4.18(.22)
1981	262,913(1,334)	187,014(263)	462,750(1,500)	74,242	20,645	3.95(.01)
1985	274,719(1,312)	194,580(185)	486,129(1,405)	82,478	23,343	3.86(.01)
1990	289,505(1,312)	204,135(185)	515,471(1,405)	92,772	26,716	3.77(.01)
1995	304,291(1,312)	213,689(185)	544,812(1,404)	103,067	30,089	3.70(.02)
2000	319,077(1,312)	223,244(185)	574,154(1,405)	113,361	33,462	3.63(.01)
2005	333,863(1,312)	232,799(185)	603,496(1,405)	123,656	36,835	3.57(.01)
2010	348,649(1,312)	242,353(185)	632,838(1,406)	133,950	40,208	3.51(.01)

TABLE G-4 (continued)

PRIMARY AREA
PROJECTED ECONOMIC ACTIVITY WITH OGS
(Direct and Indirect Impacts in Parentheses)

Year	Federal Income Taxes $1000	State Income Taxes $1000	Business Index No.	Retail Sales $1000	State Sales Taxes $1000	Assessed Property Valuation $1000
1975	32,290	6,082	133.4	237,961	6,432	172,702
1976	32,731(193)	6,324(106)	135.2	240,009(971)	6,580(35)	182,957(5,621)
1977	33,292(506)	6,632(278)	137.0	242,963(2,849)	6,761(104)	216,861(34,724)
1978	34,190(1,156)	7,125(635)	138.8	246,996(5,805)	6,982(212)	231,556(44,444)
1979	35,002(1,720)	7,571(945)	140.6	250,476(8,208)	7,182(299)	236,712(44,444)
1980	34,664(1,133)	7,385(622)	142.2	248,774(5,429)	7,194(198)	242,054(44,444)
1981	33,841(63)	6,933(34)	144.2	244,789(367)	7,122(13)	247,590(44,444)
1985	34,829(59)	7,476(33)	151.4	248,987(257)	7,570(10)	271,826(44,444)
1990	36,069(60)	8,156(32)	160.4	254,372(258)	8,134(9)	307,457(44,444)
1995	37,309(60)	8,837(33)	169.4	259,757(258)	8,699(10)	350,150(44,444)
2000	38,548(59)	9,517(32)	178.4	265,141(258)	9,263(9)	401,361(44,444)
2005	39,788(59)	10,198(33)	187.4	270,526(258)	9,827(9)	462,853(44,444)
2010	41,028(59)	10,878(32)	196.4	275,910(257)	10,392(10)	536,751(44,444)

TABLE G-4 (continued)

PRIMARY AREA
PROJECTED ECONOMIC ACTIVITY WITH OGS
(Direct and Indirect Impacts in Parentheses)

Year	Real Estate Valuation $1000	Real Estate Value Per Sq. Mile $1000/Sq Mi	Personal & Public Service Valuation $1000	Farm Income $1000	Avg. Assessed Value of Farm Land & Buildings $/Acre	Assessed Value of Farm Land & Buildings $1000
1975	133,622	92.5	39,080	39,417	67.3	56,229
1976	139,866(1,453)	96.9(1.0)	43,091(4,168)	39,636(-126)	70.7	58,847
1977	144,852(1,453)	100.3(1.0)	72,009(33,271)	39,982(-126)	72.5(0.3)	60,153(278)
1978	150,039(1,453)	103.9(1.0)	81,517(42,991)	40,327(-126)	74.5(0.8)	61,616(712)
1979	155,435(1,453)	107.6(1.0)	81,277(42,991)	40,672(-126)	77.2(2.0)	63,595(1,663)
1980	161,049(1,453)	111.5(1.0)	81,005(42,991)	41,018(-126)	79.7(3.0)	65,454(2,494)
1981	166,887(1,453)	115.6(1.0)	80,703(42,991)	41,363(-126)	80.2(2.0)	65,631(1,643)
1985	192,670(1,453)	133.4(1.0)	79,156(42,991)	42,745(-126)	84.5(0.1)	68,188(87)
1990	231,091(1,453)	160.0(1.0)	76,366(42,991)	44,472(-126)	92.5(0.1)	73,329(88)
1995	277,711(1,453)	192.3(1.0)	72,439(42,991)	46,198(-126)	100.8(0.1)	78,469(87)
2000	334,219(1,453)	231.4(1.0)	67,142(42,991)	47,925(-126)	109.4(0.1)	83,610(87)
2005	402,661(1,453)	278.8(1.0)	60,192(42,991)	49,652(-126)	118.4(0.2)	88,751(88)
2010	485,505(1,453)	336.2(1.0)	51,246(42,991)	51,379(-126)	127.6(0.1)	93,891(87)

TABLE G-4 (continued)

PRIMARY AREA
PROJECTED ECONOMIC ACTIVITY WITH OGS
(Direct and Indirect Impacts in Parentheses)

Year	Land in Farms Acres	Number of Farms No.	Average Size of Farms Acres	Bank Deposits $1000
1975	835,206	3,604	231.7	304,441
1976	832,360	3,516(1)	236.7(- 0.1)	311,091(421)
1977	829,514	3,428(2)	242.0(- 0.1)	318,004(1,105)
1978	826,668	3,342(3)	247.4(- 0.2)	325,655(2,527)
1979	823,822	3,256(4)	253.0(- 0.3)	333,116(3,759)
1980	820,976	3,172(5)	258.8(- 0.4)	338,064(2,478)
1981	818,130	3,088(6)	264.9(- 0.5)	341,953(138)
1985	806,746	2,762(9)	292.1(- 0.9)	366,861(130)
1990	792,517	2,370(12)	334.4(- 1.7)	398,006(130)
1995	778,287	1,991(14)	390.9(- 2.8)	429,151(129)
2000	764,057	1,623(17)	470.8(- 4.9)	460,297(130)
2005	749,827	1,262(18)	594.2(- 8.6)	491,442(130)
2010	735,597	907(19)	811.0(-17.4)	522,587(130)

APPENDIX H

LETTERS OF COMMENT ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

iowa department of environmental quality

January 13, 1978

Mary O'Donnell
EIS Preparation Section
U.S. Environmental Protection Agency
1735 Baltimore
Kansas City, MO 64108

Dear Mary:

This letter further details and slightly revises the air quality monitoring program discussed in section 6 of the Department of Environmental Quality's (DEQ) Environmental Impact Statement (EIS) comment letter of October 26, 1977 concerning Iowa Southern Utilities (ISU) Ottumwa Generating Station (OGS).

DEQ considers the details of this air monitoring program to be negotiable depending on problems of site selection, equipment, sampling procedures and analysis method. Also, DEQ or its representative must review and approve all details of the air monitoring program before implementation. This will include the siting selection plan, final site selection, sampling procedures, analysis methods, equipment specifications and installations, and quality assurance procedures.

ISU is aware already of DEQ construction permit air quality monitoring requirements. These basically consist of the installation and operation of three permanent monitoring sites (SO_2 and NO_x continuously and suspended particulates at each site) and an on-site meterological tower. The EIS-AQ monitoring program detailed in this letter is intended to supplement these permit monitoring requirements.

In that vein, DEQ considers the three permanent sites with the option to move the sites twice (See No. 5 below) during the course of the initial two years of operation an adequate substitute for the movile monitoring for crop damage suggested in DEQ's original EIS comment letter (See October 26 letter, section 6, paragraph 3(2)). However, if the synergestic crop damage effect of subacute levels of ozone from any source and SO_2 from OGS becomes a concern at a later date, DEQ may ask to use an OGS monitoring shelter to place a DEQ owned ozone monitor in an attempt to verify such a combination of levels.

The elements of an air monitoring program beyond DEQ construction permit monitoring requirements needed to satisfy EIS Air Quality Impact responsibilities are:

1. Collection of on-site meterological data. This is to be used to make any gausian diffusion model of OGS's Air Quality Impact as site specific as possible. EPA's research branch likely already has the expertise available to determine what on-site meterological parameters are most reasonable and appropriate for this purpose and DEQ expects EPA, Region VII, to provide ISU with that information. However, as a suggested set of parameters from which to work, DEQ offers the following:

    a. Wind speed, using identical instrumentation at three levels - 3, 10 and 30 meters.

    b. Wind direction at 30 meters.

3920 Delaware Ave., P.O. Box 3326, Des Moines, Iowa 50316 • 515/265-8134

   c. Temperature, using identical sensors at 3, 10 and 30 meters.

   d. An electronic weather station at ground level which produces a single combination tape showing relative humidity, rainfall, incoming solar radiation and wind direction.

2. Additional analysis of high-volume filters taken every six days at each of the three permanent monitor sites for:

   a. fluorides
   b. sulfates
   c. arsenic
   d. Selenium
   e. cadmium
   f. lead
   g. potentially two other heavy metals

3. Dry fallout and precipitation event sampling and analysis for fluorides, sulfates and rain pH at the three permanent monitoring sites. Rain pH should be measured as soon as practical after rainfall events.

4. Biological monitoring site requirements:

   a. Twenty sites (three coincident with permanent monitoring sites) will be chosen and four representative vegetation samples will be collected and analyzed for sulfates and fluorides semi-annually at each site (20 sites x 4 samples/site x 2 samples/year = 160 samples/year).

   b. At least 2 field mice specimens wil be taken and analyzed for fluorides semi-annually at 7 of the 20 sampling sites. Field mice are good indicators of fluorides because of small range, rapid reproduction, relative short life span and fluoride concentration in their bones.

   c. Vegetation sampling method and procedure will be specified and monitored by DEQ. One sampling site will consist of taking two samples at each of two areas 100 meters apart. Within an area, the two samples will be taken at least 10 meters apart and will consist of representative sampling from the crown, middle and lower branches of known sensitive species.

   d. Location of bee hives and sampling and analysis of bees for fluorides will be done semi-annually as bee hives are available. Up to 6 bee hive sites with 2 samples per hive may be required. Bees collect pollutants by impaction as they fly. They also have a short life span and therefore are good indicators of current conditions.

5. Monitoring sites selection - select 20 sites to include the three used in meeting permit monitoring requirements. Drawing up a siting plan and locating site possibilities will be OGS's responsibility but will be done in consultation with DEQ. Final site selection will be subject to DEQ's approval. Anticipate moving each permanent monitoring site two times during the first 2 years following plant start up to verify important findings of the other 17 biological sites.

6. Monitoring Program Time Span - All monitoring beyond permit requirement will be needed two years prior to and after plant start-up. Continued operation of up to five selected biological sites and analysis of up to three of the additional high-volume parameters (See 2 above) at all three permanent sites will be needed up through the fifth year after plant start-up.

Lastly, DEQ emphasizes that if meaningful conclusions are to be reached about the sourse of fluorides, a mass balance of fluroides need to be conducted on OGS while in operation (fluoride content of ash, stack gases and particulate) unless suitable emission factors can be provided by EPA. Without this, the fluoride monitoring efforts will be largely wasted.

If you have any questions about specifics of this monitoring program, please contact Rich Mercer of DEQ's Air and Land Quality Division.

Sincerely,

COMPLIANCE AND PLANNING DIVISION

Joseph F. Lynch
Environmental Resources Planner
Regional Programs Division

JFL:kab

iowa department of environmental quality

October 26, 1977

Dr. Kathleen Q. Camin
Regional Administrator
U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, MO 64108

Dear Dr. Camin:

The Iowa Department of Environmental Quality (DEQ) has reviewed the Iowa Southern Utilities (ISU) Ottumwa Generating Station (OGS) Draft Environment Impact Statement (EIS) issued by your office and has the following comments:

1) The draft EIS does not adequately address the environmental impact of the bottom and fly ash disposal basins as either interim storage or ultimate disposal methods for these wastes. Soil borings were taken and permeabilities were determined for the proposed disposal sites but the draft does not indicate the thickness of the confining soil layers, the depth of excavation, the basin bottom elevations relative the groundwater table nor and the nature or extent of any groundwater pollution that may result from disposal basin leachate. Further, you should be aware that within the next year DEQ will seek adoption of rules controlling all Coal Combustion Residue disposal activities. Their basis will be existing solid waste disposal statutory authority and will likely require all sites to have adequate cation exchange capacity in the confining soils to handle the waste disposal of the site along with seepage rates low enough to provide sufficient detention for the exchange to take place. It is essential that the final EIS address these matters via a discussion of the groundwater pollution potential of ash basin leachate.

Because of the proximity of the proposed basins to groundwater tables and the Des Moines River, DEQ requests the following steps be taken to ensure minimal impact of basin leachate on groundwater quality.

First, plans for the design and construction of ash basins needs to be submitted to DEQ's Air and Land Quality Division so that the proposed design can be reviewed for consistency with currently accepted engineering practice and proposed coal combustion residue rules.

Second, a groundwater monitoring plan must be designed and implemented to monitor for constituents consistent with ash content both up and down groundwater gradient of all disposal basins. It should include adequate numbers of wells and a sampling and analysis program for their use prior to and after OGS begins operating. This program should be submitted for DEQ's review and approval as soon as possible.

2) The flow, potential high iron, acidity or other quality of runoff or runoff/leachate combination from the coal storage area is not specified in the EIS. Obviously, water quality standards have to be met for this intermitent discharge but monitoring a discharge for unknown and potential toxic constituents or acidity during the actual discharge, regardless of what the Water Quality operation permit specifies as monitoring requirements, may be to late to ensure that acid or toxic discharges do not take place. Given the lack of information about the pollution potential acidity or toxicity of such a discharge a more environmentally sound solution might be to route this discharge to the bottom ash basin for treatment or provide for some type of neutralization when necessary. Even though NSPS considers such storage and discharge to be adequate treatment, does not mean that impact of such a potentially acidic discharge should not be discussed. The final EIS needs to discuss the probable acid, iron or other potentially toxic content of the coal runoff and leachate storage basin discharge and what mitigating measures are available.

3) The exact location of the discharges to the river is not contained in the draft EIS. These must be specified. Under no circumstances are discharges to Avery Creek allowable.

4) The nature or extent of any chemical or thermal block or other physical impact on river flow that may be created by the bottom ash basin discharge is not discussed, nor is the lack of or need for such mitigating measures as a diffuser on the discharge pipe. Both items need to be addressed in the final EIS.

5) Hastily constructed and abandoned temporary crossings of Avery Creek for the purpose of access to the construction site have caused considerable siltation of that important game fish nursery stream of the Des Moines River. DEQ's information as of September 1977, indicates the resulting exposed fills and cuts are still eroding and stream siltation is continuing. If this stream is to adequately recover from this siltation, repair and revegetation of slopes exposed during construction is essential and must be done at the earliest possible time. If erosion damage is extensive provisions should include riprap to prevent further siltation. Any such mitigating activities ISU is planning in order to correct these problems need to be discussed in the final EIS.

6) The air quality impact of non-criteria pollutants not covered by NSPS such as sulfates, flourides and trace elements emitted by OGS, is not addressed adequately in the final EIS. The final EIS must specify how emission rates and ground level concentrations contained in tables 4-7 thru 4-10 were estimated. Of particular concern is the lack of documentation about expected fluoride, arsenic and mercury ground level concentrations, the complete lack of any mention of sulfates, and the apparent assumption that the only form of fluoride emitted is particulate.

ISU needs to perform a fluoride mass balance study for the proposed OGS unit and include it as part of the EIS so that all fluoride emissions and resultant ground level concentrations can be estimated as closely as possible. This study should include an assessment of the variability of the fluoride content in the coal ISU has chosen to burn. The resulting range of emission rates and ground level concentrations needs to be discussed in the EIS in terms of current knowledge of the environmental impact of fluorides.

Secondly, DEQ is aware that even though NEPA requires complete assessment of environmental impact prior to plant operation, current knowledge of emission rates and prediction methods for ground level concentrations for these non-criteria pollutants has not been sufficiently verified such that their impact is known within required confidence limits. Also, sufficient research has not been performed so that adequate ambient air quality standards can be set for these pollutants. These reasons plus the fact that OGS will be burning over 2 million tons of coal a year in a location currently without pollution sources of this size leads DEQ to concluded that biological up-take and air quality monitoring for these additional air pollution parameters is necessary. It is essential that such monitoring be performed both before and after OGS begins operation in order to assure that an accurate assessment can be made of the true environmental impact of OGS's air pollutants after the plant has begun operation. Specifically, the EIS needs to address non-criteria pollutants by outlining how ISU will implement the following monitoring program at least 2 years prior to plant operation and continue after the plant begins operations until ISU and DEQ mutually agree it is no longer useful.

(1) dry fallout and precipitation event monitoring and analysis for fluorides, sulfates and rain pH,

(2) some mobile monitoring of subacute levels of SO_2 and ozone combinations in locations where crop damage or reduced productivity may occur,

(3) analysis of high-volume air sampling filters for sulfate and fluorides, and

(4) quarterly biological monitoring.

This biological monitoring program typically would consist of sites at 5 select downwind distances in each 4 directions (20 total) for (a) taking quarterly samples of conifers and agricultural plants to be analyzed for fluoride and sulfate scavanging, uptake and damage, placing corrobornating fluoride and sulfation plates for analysis, and analysis of fluoride content of the bones of known concentrators of fluorides (such as field mice).

Several areas of potential environmental impact are not well defineable at this time. These are trace element fluoride and sulfate impact on air quality and, if they occur, ash basin leachate and coal pile runoff impact on water quality. Because of this DEQ has chosen to require that ISU include as part of the final EIS exactly how these impacts will be determined or mitigated at a later date. In order to ensure that this takes place, DEQ should be consulted concerning the specific content of the final EIS prior to issuance so that we might have input into the design of any environmental impact monitoring programs that might be proposed as fullfillment of ISU's and EPA's responsibilities under NEPA.

Sincerely,

Larry E. Crane
Executive Director

LEC:JFL:cat

cc: Iowa Southern Utilities

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT. CORPS OF ENGINEERS
CLOCK TOWER BUILDING
ROCK ISLAND, ILLINOIS 61201

IN REPLY REFER TO

NCRED-PB

15 NOV 1977

Dr. Kathleen Q. Camin, Regional Administrator
US Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Dear Dr. Camin:

This office has reviewed the draft Environmental Impact Statement (EIS) for the Iowa Southern Utilities Company, Ottumwa Generating Station and offers the following comments:

1. Generally the EIS has been well prepared in an acceptable format. However, much of the technical data could be placed in appendices thus making the main text easier to read.

2. Section IV of the EIS should be expanded to include a discussion of the impacts on the operation of the generating plant, if, under severe conditions, sufficient water is not available in the Des Moines River for operation.

3. Discussion of any potential for water vapor plumes, fogging, icing, etc., as the result of the cooling system should also be included in the EIS.

4. While losses of habitat from plant construction and operation are recognized in the EIS, there appear to be no plans for mitigation or discussion of the potential for mitigation.

15 NOV 1977

5. Benthic macroinvertebrate studies in the Des Moines River apparently were limited to drift and artificial substrate sampling. No sampling was done to identify the molluscan fauna of the river, especially Pelecypods. Two unionid species, Leptodea, fragilis and L. Laevissima, have been observed by the staff immediately below Red Rock Dam. The possibility exists that these species or other unionid mussels and sphaeriid clams exist in this reach of the river. Further sampling should be initiated to determine the extent of molluscan populations.

6. The EIS does not clearly describe the siting of the outfall structure in relationship to the ordinary high water (OHW) level. Further explanation of the siting should be made. If the structure will be placed below the OHW level, an application for a Department of the Army Permit should be submitted.

We appreciate the opportunity to review this document. Please advise this office if we may be of further assistance.

Sincerely yours,

Daniel L. Lycan

DANIEL L. LYCAN
Colonel, Corps of Engineers
District Engineer

IOWA STATE
UNIVERSITY

Environmental Studies
141 Bessey Hall
Ames, Iowa 50011

Telephone 515-294-7252

November 4, 1977

Dr. Kathleen Camin
Regional Administrator
U.S. EPA
1735 Baltimore
Kansas City, MO 64100

Dear Dr. Camin:

Interested students in the course, Environmental Impact Assessment, of the Environmental Studies Program here at Iowa Sate University have prepared comments on the Draft Environmental Impact Statement of the Ottumwa Generating Station.

We respectfully offer these comments in support of the goals of NEPA for public participation and full disclosure.

Sincerely,

Craig B Davis

Craig B. Davis
Coordinator

Enclosure

I. COMMENTS ON THE CHEMICAL, PHYSICAL AND HYDRO-GEOLOGIC IMPACTS OF OGS

The past decade has seen an increasing awareness of the impacts and results of encroachment upon the floodplains of major river valleys. The Ottumwa Generating Station, being a sizeable facility, poses numerous potential impacts to the environment of the Des Moines River Valley and the Draft Environmental Impact Statement for the OBS addresses itself to only some of the impacts. The various environmental impacts and their treatment or lack thereof will be discussed on a categorical basis.

Spatial Requirements of the Facility

In order to evaluate the impacts on the floodplain by the OGS, a more definitive assessment of this intrusion is needed. The surface areal extent of the facility is specified as 795 acres. In addition, an effluent stack will extend 600 feet into the overlying airspace. No mention is made of the plant's subsurface extent, but it would be a logical assumption that a minimum of 30 to 50 feet of underlying soil will be penetrated by foundations, pilings, etc.

In addition to the physical confines of the site, additional land will be utilized by various arterial connectors including access roads, rail right-of-ways and transmission line corridors.

These spatial requirements have been poorly quantified in the Draft EIS, and insufficient justificiation is offered for them. Section 6.072 dictates 600 acres as the surface space requirement for the designed facility, and includes this as a site selection factor. However, the 30% surplus afforded by 795 acres is unexplained. Throughout the draft statement implications are made to the effect that the generating unit now proposed for the OGS is only a "first unit", leaving inference that it will be joined by another at a later date. This could explain the additional acreage acquired, but such an addition raises a host of other questions, among them ... would a supplemental EIS be researched and prepared for such an addition? If it is in the overall plans, why wasn't the addition considered in the present EIS? Will increased generating capacity at the site proportionately increase adverse environmental impacts, and if so could these be tolerated? Here the issue of "segmentation" previously raised in NEPA litigation needs to be resolved. Unfortunately, the draft statement at present sidesteps this very critical issue.

Floodplain land use impact of the other transportation corridors (excluding transmission lines) is but vaguely treated in the Draft EIS. For example, the unit coal trains are explained, but such considerations as right-of-way location in the valley and construction of these right-of-ways are ignored.

Consumptive Water Use from the Des Moines River

The primary consideration in site selection for the OGS and the reason a floodplain intrusion was even required was for the ready availability of water for consumptive use. This requirement was met at the Chillicothe location by the Des Moines River.

The consumptive demand from the Des Moines River is presented in Section 1.0441 as 17 cubic feet per second maximum and 12 cfs average. This is consistent with the river water withdrawal permit applied for with the Iowa Natural Resources Council. While comprehensive data is presented concerning average river flows and profiles in the past decade, a very crucial consideration is ignored . . . how will consumptive demand be met during sustained dry periods when the flow of the Des Moines River at the site is at or below minimum protected flow levels as specified by the Iowa NRC? At the present time the guaranteed flow to the city of Ottumwa is 300 cfs (as effluent from Red Rock Reservoir). If and when this flow cannot be maintained by natural occurrence or reservoir regulation all withdrawal rights along affected stretches as granted by an Iowa NRC permit are immediately suspended until such time as adequate flow resumes.* A two-week notice is given to all permit holders when critical flow levels are impending. Thus, a possibility exists that withdrawals from the Des Moines River in the region of the OGS site will be temporarily terminated.

How would the OGS meet such a crisis were it presently in operation? Response to this possibility is absent in the draft EIS. Obviously, the consumptive water demand of the generating facility would have to be satisfied if operation were to continue. One must merely speculate on the alternatives since they are unmentioned. Making a quick calculation based on the stated average consumptive requirement of 12 cfs, one finds for every day of operation this represents approximately 24 acre-feet of water, or 8 million gallons. This is a sizeable quantity of water to obtain from any source. It would ridiculously overtax the remote Ottumwa municipal supply. It would represent a very sizeable well field to exploit for only standby use. The most viable alternative would appear to be construction of a nearby standby reservoir that could be filled via river pumping during adequate river stages or left to fill from natural precipitation. Such a reservoir would have to be sizeable (assuming only a two-week standby capacity and an average water depth of 8 feet, 42 acres would be required), but nonetheless potentially possible due to the rolling nature of the surrounding terrain. Of course, such an undertaking would require a comprehensive impact analysis of its own.

Another serious oversight of the Draft EIS related to consumptive water use involves the proposed water intake structure along the west bank of the river channel. The location for this permanent structure was chosen because of the location of the main channel (and thus maximum water depth) along this shore. However, the exact channel location of the Des Moines River like most meandering Iowa rivers is subject to change with time, flooding, etc. Furthermore, the very presence of the intake structure in the water could cause severe enough velocity drop at its downstream face that sedimentation would be drastically accelerated in that vicinity; this would provide increased hydraulic incentive for shifting of the main channel location. An issue of serious environmental impact is then raised: if water depth became insufficient at the intake structure, what would be the recourse...channel dredging, intake relocation or what? Treatment of this entire subject is missing in the EIS.

---

*Iowa Government Publication 580 - Natural Resources Council Bylaws.

Effluent Water to the Des Moines River

While consumptive use of Des Moines River water will be made, an unknown amount of effluent water will be returned to stream. As stated in Section 4.02410, discharge will be made into the river upstream of Avery Creek. This discharge will be made only during times of "high precipitation". This statement of the effluent water discharge raises more questions than it answers.

By not specifying the exact amounts and schedule of such discharges, it is impossible to project impacts with any certainty. Discharge is also said to come from the ash basins, but with no reference or analysis to the mechanism involved...controlled pumping, weir overflow or what? The impacts of this discharge stream both in terms of the pollutants it carries and the river flow alteration it causes (channel degradation, for example) are closely related to the dispersal method. The intent to discharge during high precipitation periods implying high river stage is a good one since it would afford maximum dilution and thus minimum impact of pollutants. No mention is made of the intent or effects of discharge during periods of low flows. It is not explained if discharges would occur regardless, or if detention facilities are adequate to wait out such periods.

The issue of unprescribed water discharges into the Des Moines River is also neglected; among these would be sediment-laden rainfall runoff streams, and various contaminated leachates.

Surface runoff flows increase downstream within a watershed, the most pronounced flow being at the primary watercourse. Thus floodplains represent areas traversed by high runoff flows. At the OGS site the juncture of Avery Creek with the Des Moines River presents a classic example. The erosive potential of such runoff is augmented in most floodplain situations by the inherently alluvial nature of the soils present...Section 2.0131 of the Draft EIS identifies the soil species at the proposed site as predominantly glacial till (Kansan) and various clays, both highly erodable soil types. While the EIS stipulates that landscaping will be done in section 1.042, the exact nature of the practices is missing, as is comparative information of the runoff characteristics expected under the new regime as opposed to those of the original natural vegetative cover. This is a serious omission since alteration of drainage characteristics of a watershed has far-reaching impacts in terms of river sedimentation rates.

The runoff generated strictly by rainfall on the 795 acre site alone is of significant consequence. In terms of a concentrated one-inch rainfall, over 66 acre feet (22 million gallons) of runoff would be running from the site. With over 35 feet of topographical relief across the site (section 2.0131) considerable erosive potential is generated and should be provided for with terracing, rip-rap, etc., as required. These considerations do not appear in the draft EIS.

Coincident with these considerations is also the matter of river bank stabilization adjacent to the OGS site property. No mention is made in the draft statement of provisions to control bank slumping, erosion, and general stream meandering. Yet the location of the OGS at a bend in the river course would suggest such measures would be necessary to preserve the property. Impacts of such bank stabilization can be significant and analysis of methods to be employed is essential.

Another critical aspect of effluent waters deposited on the floodplain is the potential impact of these waters on subsurface aquifers typically found associated with river valleys. The draft EIS mentions the water bearing formations in the area (4 in number), attributing their recharge in a general way to "precipitation" (section 2.023). Furthermore, the assumption is made that they are protected from contamination by any effluents by the presence of an overbearing aquiclude formation. This entire analysis is weak; exact recharge mechanisms for the aquifers should be determined and reported, and the structural integrity of the aquiclude should be confirmed rather than assumed. The type of strata comprising the aquiclude is also relevant information found to be lacking in the draft statement. Contamination of groundwater supplies is an ultra-important concern due to its irreversibility, and should not be dismissed so lightly.

The preliminary settling of the aqueous effluent streams in the proposed ash basins is an acceptable design if adequately considered. However, recognition of the irretrievable commitment of some 70 acres of land to this use is absent. Once the design life of these pits is exhausted and they are filled with settled precipitates, what is to come of them? The toxic nature of the solids comprising the fill precludes most future uses of those acres without extensive reclamation. The OGS draft EIS statement misses this issue, with a resulting implication that is in clear conflict with the "next use" stewardship of our land resources.

Floodwater Control

The matter of flood control provisions at the OGS is poorly addressed by the draft EIS statement. Mention is made of the design of the water intake structure for the 50-year flood, but no similar criteria are presented for the rest of the facilities.

Impacts of flooding of the site or parts thereof could range from mild to severe. No analysis is offered, but is well warranted. Flooding of roadway grades and other earthen structures would have serious implications in terms of potential erosion. Of worst consequence would be overtopping or outwash of the ash pond dikes by floodwaters, liberating a host of toxic wastes.

Construction Practices on the Floodplain

The construction period for the OGS will be an environmentally critical one in terms of the existing potential for some uniquely severe impacts. During the construction phase the physical characteristics of the site are undergoing drastic changes, and in the interim are especially susceptible to degradation.

The clearing and grading processes expose and rearrange the soil strata of the area making a variety of impacts possible. Soil erosion is at a maximum potential at this time, and consequently so is siltation of adjacent watercourses. Section 4.0117 of the EIS acknowledges an increase in river turbidity during construction but makes no analysis of the resulting impacts. The degree of such turbidity increases is keynote in determining their adverse effect, but no such projection is made. Rather, the reference to "revegetation as soon as possible" is apparently assumed to remedy or prevent all impacts.

The temporary structures associated with a large scale construction project also escape impact analysis...such things as temporary roadways and vehicle accesses, machinery storage areas, materials handling depots, etc. The impact of these on the fragile floodplain could be substantial but goes unmentioned. Removal of all temporary structures, particularly earthen ones, would be a crucial consideration, but may not be provided for.

The legality of floodplain construction is a matter that needs explanation. Such construction requires by Iowa law permits from both the Natural Resources Council and the Iowa Conservation Commission. The former agency is conducting a three-phase approval program for the permit grant, the last phase of which is yet to be completed. Yet the EIS lists a "tentative approval" on January 6, 1976 in section 9.04. No such "tentative" classification appears in the bylaws of the Iowa Natural Resources Council, suggesting a legal infraction by the initiation of clearing and grading operations on the OGS site in March of 1976. Further bending of the law appears to have occurred by anticipating the construction permit from the ICC, issued only in late May of 1976.

Transmission Line Routing

Another important impact that is ongoing is the issue of the transmission lines and supporting facilities. Of central concern is the loss of prime Iowa farmland from productive use if these additional transmission facilities have to be built to transfer the power generated at OGS to other parts of the state. According to the draft, only two plans are under consideration: five 161 KV lines or one 345 KV with three 161 KV lines planned for overhead distribution on AC carriers. The amount of land taken out of productive use for this overhead distribution scheme figures roughly to forty acres/mile,* so the total loss would be significant when extended over the proposed distribution network for the state. Thre was no mention of citizen input into the decision process involving route selection, nor any mention of how prices for the right-of-ways would be determined. No mention was made of the possibility of constructing higher voltage lines, thus cutting the right-of-way approximately in half, since for example, a single circuit 765 KV line has the load-carrying capacity equivalent to five single circuit 138 KV lines.

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*Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 & 4...Energy Planning Division, Montana State Dept. of Natural Resources and Conservation; p. 250, table 9-1, vol. 1.

I. COMMENTS ON THE CHEMICAL, PHYSICAL AND HYDRO-GEOLOGICAL EFFECTS OF OGS IMPACTS

Summarized by Section

Section 1.0441. Amount of consumptive water use from Des Moines River. Average and maximum amounts of withdrawal are specified and itemized; however, it is not clear what allowance is made for securing these amounts during periods of protected flow in the river. Likewise, little mention is made of the significance of the withdrawn amounts relative to the total river flow at various seasonal stages.

A discussion of alternative water sources and their associated impact is needed. Different impacts would result if, for example, water were purchased and piped from Ottumwa, wells were sunk into the aquifers underlying the site, or an on-site standby water reservoir was built. The Des Moines River is close to protected flow status at this time.

4.0241. The amount of effluent water discharged back to the Des Moines River is not specified or even projected; one only gathers that it will come from the ash pond and coal pile.

No quality index is given for the proposed effluent; one must merely speculate on its contents from the nature of the wastes going into the ponds. Pollution is to be minimized by release only during periods of "high precipitation". If precipitation is scarce over an extended period of time, no alternative is proposed. The total volume of water wasted daily in the plant is not given so it is impossible to figure the holdover capacity of the ponds.

2.0232. Contamination of sub-surface aquifers in the region. Aquifers shown in vicinity number 4, but the presence of an impermeable aquiclude is undocumented; thus, protection of aquifers is an assumption.

2.0233. Effect of intake structure on changes in velocity of the river is not mentioned. It could be of serious consequence since abrupt velocity drops cause sedimentation and could build up substantial silt bars with time.

2.0131. No direct mention is made of the effect of ash pond dikes on flood flows in river valley; also other site structures as obstructing floor flows. The inference is made that differences in elevation of 25 to 35 feet from pond to water surface of river is implicit protection from floodwaters ever reaching the dikes.

4.0117. Mention of reseeding and retention of natural drainage courses was made, but no impact assessment was made of the presumably inevitable alterations that do occur in natural watershed drainage.

1.042. There exists the question of sustained erosion on site. Mere mention of "adequate landscaping" is made and presumably would include grasses and shrubs. However, an industrial site would likely cause higher degrees of sustained soil erosion than would the naturally existing ground cover.

1.04934. What becomes of ash pits when their design life is exhausted and they are full of solids? Only mentioned that sometime in the future the ash basins may be abandoned; no mention of their fate is made. Reclamation apparently is not considered as an alternative, although without it the "next use" of the land on the site is very severely limited.

4.02433. If Des Moines River channel changes location with time as it is possible, what are the options for mitigation and the resulting impacts? Most directly affected appears to be the intake structure whose location was dictated by the presence of the river channel (now along the west bank.) However, no recognition is made of a potential for change and the effects thereof.

The design of excavation, piling, weirs, etc., for building foundations is not mentioned. This is an important consideration since impacts vary in nature and severity for different foundation installations. For example, 30 feet of open pit with poured footings as opposed to 4 feet of excavation with driven piles.

Operation and choice of construction machinery is not discussed. There is a considerable difference in the earth disturbance and vegetation destruction from crawler type vehicles as compared with floatation wheeled machines.

4.0117. Soil losses during this period when earth is exposed should be discussed. The importance of sound construction practices is emphasized, but no definite criteria are mentioned. Also, no estimate of the extent of earth exposure is made.

4.01171. Increases in turbidity of Des Moines River and Avery Creek during grading, clearing and construction is not adequately treated. Significant turbidity increases are acknowledged, but written off as being unavoidable. No impact associated with this is given; the whole issue is rationalized on the grounds of being temporary.

Alteration of natural soil profiles in area due to grading and filling is not mentioned. However, this could be significant in terms of changed erodability, percolation characteristics, adaptability of vegetative cover, etc.

4.011,1.048. Temporary and permanent transportation courses in the vicinity of the site call for proper construction practices, but quantitative analysis is lacking. Merely, grading and seeding are to be used to minimize erosion. No discussion of the choice of these courses is made. The status of rail service in the area is rather unclear.

4.01183. Disposal of debris from construction needs discussion. Burial of rubbish on a floodplain? This invites leaching and outwash contamination of the Des Moines River. Could even be in violation of state law.

4.01194. The composite noise level of 90 dBA is predicted to attenuate to 68 dBA outside the house and assumed to attenuate further to about 48 dBA inside the structure based on "general effect of most walls", they did not go to a house and check if its walls will absorb 20 dBA of sound; also no consideration was given for open windows during summer which would definitely increase the noise levels indoors; says noise level outside is noticeable but should be acceptable as a "temporary nuisance"; no time duration given for the term "temporary" -- could be several years.

4.01196. Fig. 4-1 on noise levels for one locomotive nearly incomprehensible; gives data points for noise levels of locomotive at various speeds but does not say at what speed the trains will be traveling. No inclusion of frequency of train deliveries; so inclusion of possible Doppler shifting of frequency to a more annoying value due to certain train speeds and distances.

4.01197. Attempt to justify increasing noise levels due to spur line on basis of status quo argument--residents are already used to noise from Burlington Northern Railroad, so they shouldn't consider the slight increase in noise levels as a nuisance; no figures given for estimated noise levels on spur lines and attenuation at nearby houses.

4.01198. Sound levels in the surrounding community believed to be "quite tolerable" on basis of above "worst scenarios" yet above cases are incomplete and based on models that are not backed by hard data measurements.

4.023. Statement says, "disturbance characteristics of noise are subjective", which is probably generally true but does not mention that the high frequency noise is more annoying to the human ear.

4.0231. Inclusion of four significant EPA noise level guidelines is good but the unit of dBA is not defined for the reader nor are there reference values to give the reader some idea of just, for example, what 60 dBA compares to in everyday experience; state that dBA values should not be thought of as discrete values since they are defined in terms of energy equivalents--confusing statement that sheds no light on the values at all.

4.0233. The EIS has identified major producers of operational noise but does not include added noise when train with coal comes to the plant at the same time it is operating at full capacity.

4.0235. No real justification given for assuming Ottumwa residents will not hear OGS operational noise although almost undoubtedly true.

4.02311. The EIS attempts to justify high dBA readings by taking into account attenuation by grasses, trees, etc., giving misleading example where the effect of above on 1000 Hz tone at 2.5 meters above ground but it doesn't say that the majority (or any) of the plant operation noise will be at 1000 Hz, therefore the real value could be higher or lower.

6.12. Alternative Cooling Methods. This section states that the energy in the exhaust steam is "unrecoverable" and thus "waste" heat; this is certainly not true--the steam can sometimes be used to drive further topping cycle devices and could be used as a source of heat at the very least in the OGS buildings and possibly for the nearby town of Chillicothe. No mention is made of any studies at these possibilities.

6.125. Table 6-5 on comparative qualitative ranking of each cooling alternative for a number of individual cooling systems characteristics is a good idea, but because the ratings are qualitative and they don't state how they decided on the index to rate the systems, therefore it is misleading.

No mention of any disadvantages of evaporative coolers such as (1) discharge large quantities of humid air out over the environment, constantly emitting clouds and changing the average humidity in the local area, (2) to prevent corrosion and fouling by organic growths, many different kinds of chemicals are added to the water and as blown out over the countryside, added to the environment; possible impact on crops in this area, (3) problems associated with this type of cooling scheme during the winter months. Sec. 6.126 states where will be "no thermal impacts as a result of wastewater discharges," but the water is to be recycled for cooling "as much as possible," implying some dumping at some future time.

6.081. Transmission Systems: The basis for decision making is system reliability and operation, system stability, economics and coordination with future requirements. They are not analytically committed to finding the least environmentally damaging method.

6.082. Transmission routing decisions section is devoid of discussion on citizen input. No mention of estimates of land-use involved for the systems under consideration; no estimate of time involved for construction of transmission systems; questionable statements in 6.08212 on the impact of the transmission system on ponds and shoreline wildlife habitats. Input from the U.S. Fish & Wildlife Service should be sought on impacts to migrating birds.

6.083. Alternate transmission strategies are poorly treated. Systems under consideration are five 161 KV lines and one 345 KV with three 161KV lines; absolutely no mention of (1) higher voltage line possibilities, (2) DC transmission strategies, (3) underground transmission.

4.024. Water Quality: Data given pertains to water flows and baseline concentrations in the Des Moines River and Avery Creek. No attempt was made to evaluate impacts.

4.0241. Since composition of the coal is not known, it is impossible to determine the chemical composition of waste water discharges. All toxic substances, solids, and trace elements can cause changes in the resultant quality of the water affecting aquatic life, recreational use, and human consumption. Both the Des Moines River and Avery Creek will be affected. Sources of pollution would be in the form of dissolved solids from the ash basin, e.g., leaching.

1.0451. Runoff will be into a 2.2 acre basin. What will the impact of this basin do to the surrounding environment? Coal piles can also pose ecosystem threats in the way of leaching and dust.

1.0431. All plant wastes will flow into the bottom ash basin where setting out of suspended solids and pH equalization of plant wastes will occur. A complete inventory of wastes according to pH must be given to show how chemical balances will be maintained without added chemicals. Federal regulations (i.e., USEPA) impose limitations on the pH of liquid effluents from new large power plants, and the quantities of selected contaminates including chlorine in the various streams which may be discharged. pH ranges are also closely regulated.

No mention of trace elements is given and their impacts on hydrologic and biochemical cycles. Found to be of concern are: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc.

The ash basins are said to be self-sealing, but no defense of this statement is given. Without adequate protection soluble solids of all types are dissolved by the downward percolation of water. Effects of leaching may not be experienced for many years (5-10) but could show up and foul water supplies.

2.08. Ambient Air Quality: Too much time was given to monitoring devices and techniques, and none about results of the study. Data should also contain baseline readings of hydrocarbons, ozone, CO, as well as expected trace elements in aerosols.

On TSP's, the NAAQS is not included here to enable the reader to see the quality at the city site, also inadequate in reporting other air pollutants that could be expected at the plant site, i.e., heavy metals.

Hydrocarbons are emitted during startup and shutdown, and should be mentioned; especially a projection of the carcinogenic polycyclic aromatic hydrocarbons resulting from incomplete combustion. Although not in high concentrations they may combine photochemically with other atmospheric elements and produce additional carcinogenic agents as POM and benzo(a)pyrene.

1.04921. Not enough information given on furnace design and if it will reduce NO_2 emissions. State specifications and principles involved. No impact was given for NO_2 or other nitrogen oxides that are to be released. Both have adverse effects on human health, wildlife, and vegetation.

1.04923, 4.0218, 6.09. Although particulates are spoken of in terms of a system, no justification of the choice of an electrostatic precipitator over other systems or the impact of the approximately 1% particulates on the environment, including health and respiratory problems.

There is a serious lack of information on the coal source and statistical evaluation of potential pollutant emissions which requies a more complete coal analysis than is given. The SO_2 emissions, for example, could exceed NSPS frequently, since the data given are provisional.

Needed are specifics on coal type, and various models and efficiencies of SO_2 removal systems, and impacts of SO_2 that will be released. No mention has been made of the adverse health, vegetation, material destruction. and effects of sulfur emissions.

No assessment of toxic trace elements or toxic compounds is made. Possible elements emitted that cause greatest harm: arsenic, antimony, barium, cadmium, chromium, copper, fluoride, mercury, lead, selenium, thorium, uranium, and zinc. All of these should be analyzed, their emission rates and impacts should be evaluated and mass balance presented based on Radian Corp.'s studies for EPA.

Estimations of damage impacts of all these air pollutants should be given so the public can be informed. Crop and vegetation damage, soiling, maintenance and cleaning costs, degradation of rubber, stone, concrete and glass are all very real and need to be evaluated.

II.
HEALTH, ECOLOGICAL AND WILDLIFE CONSIDERATIONS

In the Draft Environmental Impact Statement of the proposed Ottumwa Generating Station, ambiguities, generalities and omissions are frequent and noticeable. These shortcomings result in the failure of this draft EIS to comply with the requirements of the National Environmental Policy Act (NEPA).

According to Section 102(2)(c) of NEPA, "include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official." The draft EIS of the Ottumwa station does not comply with this. Generalities abound in place of detailed analysis.

Furthermore, in EDF vs Corps of Engineers, the Court said that full disclosure should, at a minimum, produce a statement that will alert the public to all known possible environmental consequences of the proposed agency action. Again, we feel this preliminary draft EIS does not comply with the requirement.

In the following critique we have outlined certain omissions and flaws of this EIS with the expectation that further information will be provided to the satisfaction of this committee and the public.

1. Omission of impacts of the project on human health.

No information is presented in the preliminary draft EIS on the project's impacts on human health. It is known that the discharge of some air pollutants, most notably SO_x, NO_2, water vapor, fluorides and particulates, can cause respiratory ailments or aggravate the conditions of eye irritation, heart disease and other internal disorders. Despite the claim that the plant will not cause air pollution levels exceeding ambient air quality standards, no evaluation was made of the effect that air quality degradation resulting from the project will have on those persons working in the area and those persons living in the nearby area.

2. A diffusion modeling analysis has been presented in the draft EIS to show that the discharge of air pollutants will not violate the ambient air quality standards of the region. However, the discharge of pollutants into the air, such as sulfur dioxide, nitrogen oxides and fluorides can have an effect on the agricultural economy of the affected area. Specifically, the impact of these pollutants on crops in the area should be dealt with. Why is no information contained in the preliminary draft EIS pointing this out relative to EPA's own reports on crop sensitivity?

Sulfur dioxide and fluorides especially have been shown to have an adverse effect on crops such as soy beans, alfalfa, oats, red clover, wheat and rye, even below ambient air quality standards. NEPA directs that the economic impacts of such possible crop damage from these air pollutants must be dealt with.

Equally important, it should be determined what impact the discharge of air pollutants will have on wildlife habitats in areas near the plant site. More specifically, a review of animal and bird species which might be affected by possible deterioration of the plant communities caused by these pollutants in addition to any direct effects.

A discussion of the possibility of "acid rain" resulting from sulfur dioxide would also be appropriate and should be included.

The draft EIS does not discuss the impact of OGS on potable downstream uses of Des Moines River water. The statement should provide an inventory of downstream uses, most important being that of drinking water quality. Not only should present uses be considered, but also projected users.

The generating station's effect on the aquatic ecology downstream should also be considered and particularly should include consideration of game fish populations.

The draft EIS does not treat the ecological impacts of the extraction of coal and its transportation to the site. Questions which arise are, "What effects will the mining of Western coal have on the ecology there?" "Will the strip mined land be reclaimed?" "If so, to what extent can it be reclaimed?" "What evidence is there to support these findings "

The impacts projected by the draft EIS for the terrestrial plant and animal communities can in no way be interpreted as a "detailed" analysis. The statement says nothing more than, in effect, there will be considerable habitat destruction resulting in displacement and elimination of certain species. Sufficient information exists in the relevant literature to project specific species-by-species impacts given the description of the area in 2.06 and 2.07. An assessment is needed of the plant communities and the proportion of these plant communities and species that will be destroyed during construction. This could be facilitated by plotting construction activities on a vegetation map. An estimate of the decline or displacement of each species could be made by using the habitat requirement data, available in the relevant literature of each specie in question.

Further detailed analysis should be made of the effects up the food web from each herbivore by using the principles of the food web. The food chain relationships are of the utmost ecological importance because they define the dependence of each species on all other species. The impact statement should discuss this interdepenedence.

Other considerations needed in the EIS include the importance of the area to migrating waterfowl and in what ways they will be affected. Concern should not be centered solely on the construction area, but also consider the possibilities for impacts on the surrounding areas (e.g., diminished use of the riverine habitat and impacts on breeding populations).

Other potential wildlife impacts should be discussed: (1) deer population status and effects on range and patterns of movement should be determined; (2) the value of the area to birds of prey and wide ranging mammalian carnivores; and (3) the functions of the area for migratory birds.

Very little information is presented on the impacts of the project on the aquatic systems of the Des Moines River and Avery Creek. It is stated that erosion will occur during plant construction and that it will cause a temporary increase in turbidity of these waters. A prediction of soil loss can be made by engineers and should be done. The level of turbidity which will be reached in Avery Creek and the Des Moines River, and how long it will last, should be stated and quantified.

The long range effects of suspended sediment on benthos and primary productivity should be assessed. Avery Creek is very important as a spawning ground for game fish populations. Construction activities are bound to have a direct detrimental effect on benthos plankton and larval fish populations. This obvious impact should be quantified and discussed. The future of game fish populations in the Des Moines River as affected by the OGS project should be thoroughly covered in the EIS.

The draft EIS states that thermal pollution due to the project will be "minimal". The statement never specifies what the temperature of the waste water discharged to the river will be at various times of the year and even if it will exceed State water quality standards. According to Iowa Water Quality Standards, in Class B streams such as the Des Moines River no heat shall be added that will cause an increase in temperature of over 5° F and not more than a 2° F increase per hour. The total temperature can never rise above 90° F. The preliminary EIS provides no information, facts or analysis that show if they will be able to comply with this.

Other specific questions should be answered. How does the temperature of the waste water discharged compare to the normal temperature of the river water? What effect will the waste water discharged have on the river water temperature and will the temperature change affect the ecosystem (e.g., how will it change game fish populations and larval fish populations in these waters)? What will be the overall quality of the waste water discharged to the river? What will be the BOD, heavy metals and other parameters of the discharge water and how will this affect DO levels in the river? What is the threat of heavy metals and salts from the ash ponds to aquatic life of the river? The possibility of the heavy metal ions increasing by biological magnification must also be considered in detail.

In conclusion, it should be emphasized that the NEPA Court cases of EDF vs Corps of Engineers, Daly vs Volpe, and Brooks vs Volpe, to name a few, hold that the environmental impact statement cannot be structured in the form of "findings", but rather must be an objective presentation of all the facts, pro and con. The language in much of the preliminary EIS does not lend itself well to such an interpretation.

Specifically, the description of the present site condition violates the requirement of objectivity. The tone of the writing tends to downgrade the importance of the area as a natural site rather than presenting the issue objectively. The use of the words "typical" and "disturbed" in Section 4.0111 does not objectively describe the environmental value of the area to humans and wildlife. The tone insinuates that it isn't even a part of the natural environment because it has been disturbed, indicating that the authors believe the "natural environment" there isn't worth worrying about. This is biased treatment and is false. The natural environment of much of Iowa has been at some period "disturbed". Planned disturbance and control of vegetative succession is, in fact, a valid wildlife management technique. The tone of the draft EIS should be changed such that it presents an objective view of the facts and alternatives.

COMMUNITY ACTION RESEARCH GROUP

3 November 1977

Mr. Edward Vest,
EIS Coordinator
Region VII, EPA
1735 Balitmore
Kansas City, Kansas 64108

Dear Mr. Vest,

on the proposed draft EIS for the Ottumwa Generating Station

Enclosed are the comments/filed by myself and the Community Action Research Group (CARG) on behalf of ourselves, the ISU chapter of Iowa PIRG, Dubuque Environmental Coordinating Committee and Citizens United for Responsible Energy. Thank you for both your patience and assistance in this matter.

As noted in the paper itself, CARG has suggested that EPA would benefit from more active involement by citizen groups in EPA's EIS review process beginning as early as the drafting of an outline for the EIS. To carry out this suggestion, we have urged that EPA identify possible methods of groups which EPA believes will help develop a more complete record. Because of our financial limitations, we were unable to provide as much comment as we felt would be appropriate or in as much depth as we believe necessary to clarify our points. Nonetheless, we believe our comments represent an important focus and hope you will read them carefully.

If you have any questions regarding the critique, please give me a call. Again, thank you for your help.

Sincerely,

Marve Peterson
for

Skip Laitner
Director, Energy & Utilities
Project

cc: Dr. Kathleen Camin

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This is recycled paper.

COMMENTS UPON THE PROPOSED DRAFT EIS
FOR THE OTTUMWA GENERATING STATION
WAPELLO COUNTY, IOWA

Prepared by

Skip Laitner, Director
Energy & Utility Project
Community Action Research Group (CARG)

On behalf of

Community Action Research Group (CARG)
Iowa State University - Iowa Public Interest Research Group
Dubuque Environmental Coordinating Committee
Citizens United for Responsible Energy (CURE)

To

U.S. Environmental Protection Agency
Region VII
Kansas City, Mo. 64108

November 3, 1977

I. INTRODUCTION

A. Citizen Participation

This paper is written in response to the Environmental Protection Agency's (EPA) invitation to comment upon the environmental and economic impacts of Iowa Southern Utilities' proposed 727 megawatt coal-fired steam-electric generating station (OGS) to be located approximately 8 miles northeast of Ottumwa, Iowa. Because of sharp limitations on time, money and staff members with sufficient expertise to comment _fully_ upon the Environmental Impact Assessment (EIA)* circulated in August 1977 by EPA, this paper will be restricted to the several major issue areas discussed below.

It should be noted, however, that CARG believes substantially more comment could have been provided had resources been available. Because this unfortunate situation exists for most citizen organizations -- and CARG is in perhaps the best financial condition of any such group in Iowa -- EPA and other federal agencies are deprived of valuable input and participation from citizens, not only in terms of the EIS review process but also in terms of identifying areas of controversy and assisting the agency in its evaluation of a project at its inception.

"[T]he need to ensure a complete record" has been cited in decisions granting petitions to intervene in agency proceedings. New York Department of Environmental Conservation, Opinion on Motions to Intervene, File No. 2833, November 19, 1975, at 3. There are several reasons why the presence of intervenors is helpful in ensuring a complete record. "Courts and commentators have increasingly recognized that substantial benefits may be accrued from the participation of groups such as NRDC (Natural Resources Defense Council), petitioning to intervene, which force not only the parties but also the hearing officer to consider a broader range of argument and interests than might otherwise receive consideration." _Id._, at 12-13. _See generally_ E. Gellhorn, _Public Participation in Administrative Proceedings_, 81 Yale L.J. 359 (1972); Comment, _Public Participation in Federal Administrative Proceedings_, 120 U. Pa.L.Rev. 702 (1972). The same logic applies to an agency's planning and evaluation procedures as well, especially in the NEPA review process.

The U.S. Nuclear Regulatory Commission has said, "Our experience suggests that the intervenor as gadfly has performed a useful function in some situations. In contested cases with active intervenors, the staff does seem to be somewhat better prepared and the hearing record developed as a result goes into somewhat greater depth on issues in which the intervenors show an interest." U.S. Nuclear Regulatory Commission (hereinafter "NRC"), _Financial Assistance to Participants in Commission Proceedings -- Statement of Considerations Terminating Rulemaking_, November 12, 1976, at 22. "It is natural to expect that the staff would be somewhat better prepared for hearings which are contested..." _Id._, at 23.

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*For reasons discussed in section II of this paper, CARG will refer to EPA document numbered EPA-907/9-77-004 as an EIA rather than an EIS.

NRC Commissioner Gilinsky added, "This in no way reflects discredit on our staff...[T]hey are assiduous in their efforts to protect the public interest...[F]or the most part...staff understands clearly its public mission, is dedicated to the achievement of that mission, and spends whatever effort is required for the task...[I]ntervenors...will likely tend to promote conditions favorable to this attitude and this effectiveness...[They] will help to keep our staff on guard during earlier, less formal stages of our proceedings, and at the same time promote a full airing of controversy during the public stages of our regulatory process." Id., Separate Views of Commissioner Gilinsky, at 1-2.

Gilinsky continues with a description of NRC proceedings which is analogous to contested cases before this Commission. "Whether in licensing or rulemaking, the nature of our process is such as to encourage our staff, after careful review of relevant factors, to develop a particular point of view by the time public stages are reached and to become 'advocates' for this emerging position." Id., Separate Views, at 2.

Citizen participation can bring a fresh perspective to the NEPA review process. In the Environmental Impact Assessment required by EPA, the utility company must exercise considerable judgment in its evaluations of future load projections, environmental and economic costs and the local impacts of power plant construction. In virtually all cases, the power company will rely on professional consultants to go into the area, abstract the relevant information, and make careful projections. While much is to be said for this science, it seems inevitable that the consultants will represent a narrow, specific point of view -- that of the utility funding the project. Citizens, with better financial resources, could offer an alternative viewpoint on such matters thus building a stronger record for EPA to make a final judgment. In aggressively developing a complete record, the agency will be minimizing judicial challenges since it will have made a good-faith attempt to fully evaluate a proposal by including all points of view on the matter.

To assist citizen groups in the EIS evaluation process, EPA should review its existing authority to identify measures which will fully involve citizens in the process as early as possible and which will provide financial assistance to responsible citizen groups which the agency believes can make a meaningful contribution to the project evaluation. If EPA believes that such authority is lacking, then it should propose those policies or congressional action which will strengthen existing authority. This would be consistent with Section 103 of the National Environmental Policy Act (PL 91-190) which states that federal agencies shal propose to the President "such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act."

B. EIS Guidelines

Under the mandate of the National Environmental Policy Act (NEPA), the Environmental Impact Statement (EIS) is intended to be a full disclosure document which examines (i) all environmental impacts of a proposed action, (ii) any unavoidable adverse environmental effects, (iii) alternatives to a proposed action, (iv) the relationship between local, short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources should a proposed action be undertaken. 42 U.S.C., §4332(2)(c).

NEPA calls for compliance with these requirements to the "fullest extent possible." 42 U.S.C., §4332. For a period of time, federal agencies interpreted these statements as being guidelines rather than requirements. The Court effectively destroyed that perception, however, in Calvert Cliffs v. AEC, 449 F.2d 1109 (D.C. Cir. 1971), cert denied 404 U.S. 942 (1972). In that case, Judge Wright held:

> "The Act also contains some very important 'procedural provisions' -- provisions which are designed to see that all federal agencies do, in fact, exercise the substantive discretion given them. These provisions are not highly flexible. Indeed, they establish a strict standard of compliance." Id.

This standard of strict compliance has been upheld almost universally by the courts in considering Section 102(2)(c) of NEPA. See, for example, EDF v. Corps of Engineers (Gilham Dam), 342 F. Supp. 1211 (D. E. Ark 1972), 470 F. 2d 289 (8th Cir., 1972) cert denied 412 U.S. 908 (1973) and particularly Sierra Club v. Froehlke, 345 F. Supp. 440 (D. W.Wis., 1972).

With this standard of strict compliance in mind, and in view of the magnitude of the proposed project (the direct costs of which will likely exceed two billion dollars over its 30 year life-time when the total fuel and maintenance costs are added to the plant's fixed costs), CARG has examined the EIA (see footnote on page one) and found it to be considerably less than a full disclosure document. By comparison, the Department of Interior has developed a set of guidelines which if followed in writing an EIA, would fulfill the standard of strict compliance. See Guidelines for the Preparation of Environmental Reports for Fossil-Fueled Steam Electric Generating Stations, prepared for the U.S. Department of Interior's Office of Water Research and Technology and Office of Environmental Project Review, November 1976 (hereinafter "DOI guidelines").

CARG hereby incorporates, by reference, the DOI guidelines as part of its comments and requests that the EPA, using these guidelines as a comparison, identify deficiencies in the EIA and, where appropriate, make the necessary corrections and additions to the statement. In Sierra Club v. Morton, 395 F. Supp. 1187 (D.D.C. 1975), the Department of Interior, defendant, argued that the filing of a detailed EIS with respect to annual budget proposals would create a difficult administrative burden. Judge Pratt ruled that mere administrative difficulties could not justify the failure to comply with NEPA. Id. at 1189, 90. Again, in view of the enormous financial and environmental impact resulting from the project, this burden is not an unreasonable one. In using the DOI guidelines as a reference, it should be noted that these are currently being reviewed by the Department for possible amendment

However, this in no way detracts from their usefulness in the current situation, especially in view of the contributions made in their development by more than 30 persons representing some 15 disciplines and from interviews with 17 federal agencies including the EPA.

II. AN "EIA", NOT AN "EIS"

EPA, like many other federal agencies , has requested from an applicant a technical report referred to as an Environmental Impact Assessment (EIA). Rather than using this document as part of its informational resources, EPA has, with some minor editing, reissued the EIA as its draft EIS. It is CARG's contention that EPA document number EPA-907/9-77-004, issued in August, 1977, is not an EIS required by NEPA, but only an EIA that the agency is circulating for comment. Former Region VII Administrator Jerome Svore, in a letter dated April 21, 1976 to Mr. D.H. McLeod, Production Manager for Iowa Southern Utilities (ISU) stated that the EIA would serve "both as ISU's Assessment and as the Environmental Protection Agency's (EPA) statement on the proposed permit action." This is in violation of both the letter and spirit of the law.

Our interpretation of relevant regulations and court decisions suggest that an EIA is distinct from an EIS, although in some cases a federal agency may delegate the writing of the EIS to other parties. Guidelines promulgated by the Council on Environmental Quality (CEQ) state:

> "Where an agency relies on an applicant to submit initial environmental information, the agency should assist the applicant by outlining the types of information required. In all cases, the agency should make its own evaluation of the environmental issues and take responsibility for the scope and content of draft and final environmental statements." 40 C.F.R., §1500.7(c).

Within this statement there are three items of importance to be noted: 1) that CEQ clearly distinguishes between an applicant's submission of "initial environmental information" (which CARG takes to mean an "EIA") and an EIS*; 2) when an agency asks for an EIA it should actively assist the applicant by outlining the specific information needed by the agency in order for it to comply with NEPA; and 3) after receiving the EIA, an agency should make its own evaluation of the data contained in the EIA.

As to the first point, that there is a significant difference between an EIA submitted by an applicant and an EIS issued by an agency, the DOI guidelines, referred to in part I of this paper, state:

> "For the purposes of these Guidelines the Environmental Report [or EIA] is a technical document prepared by an applicant to provide relevant information to the authorizing agency to assist that agency in making its own environmental analysis prior to approving a permit. Notwithstanding the Department's obligation to prepare an

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*See Environmental Defense Fund v. Tennessee Valley Authority, 468 F. 2d 1164 (6th Cir. 1972), which states that the CEQ guidelines are entitled to great weight, and constitute a persuasive interpretation of NEPA.

> an independent EIS, the applicant's [EIA] remains the prime source of information for the EIS and the more closely the [EIA] comprehends the needs of the EIS, the greater will be its value." (Emphasis added.) DOI guidelines, op. cit., p. vii.

Again it is clear that the EIA and the EIS are two distinct documents. The extent to which the two overlap depends upon whether requirements of items two and three above have been met and whether an EIS can be delegated to Iowa Southern Utilities. As to item two, there is no evidence that EPA assisted ISU in the preparation of the EIA as required by the CEQ guidelines. In a September 14, 1977 letter from McChord Carrico, Assistant General Counsel for ISU, to Dr. Kathleen Camin, Region VII Administrator, a chronology of events relating to the preparation of an EIS was outlined. According to Carrico, EPA first notified ISU by phone on January 5, 1976 that it would be the lead agency in the EIS review process for OGS. At that time EPA requested copies of the draft EIS (i.e., the EIA prepared for ISU by Black & Veatch which Carrico improperly referred to as the EIS). On February 6, 1976, six copies were delivered to EPA offices in Kansas City. Carrico letter, op. cit., p. 11.

Within the time frame of some 30 plus days, it would be impossible both for EPA to assist in the development of the EIA and for ISU to complete the document. Hence, the writing obiviously was begun well in advance of the time during which EPA assumed lead agency status which means that EPA has failed its first obligation to assist in the preparation of the EIA. Further, there is no record, either in the EIA or in the information obtained by CARG on August 25, 1977 under a Freedom of Information Act Request that EPA was involved in its preparation other than a July 24, 1975 meeting at which EPA advised ISU of the need to comply with the NEPA process.

Has EPA independently evaluated the EIA? Again, there is nothing in the record to suggest that it has. The documents provided by EPA to CARG through the FOIS request previously cited, contain no reference to an independent evaluation by EPA of the data contained in the EIA. Nor is there evidence in the EIA itself which cites studies, interviews, or staff reviews of the EIA information. For example, section 4.0241, page IV-28 of the EIA states that "[c]alculations show that even during summer conditions of high humidity and temperature, the pond water will have a temperature not greater than 5 F above ambient temperature." However, none of EPA's references cite an independent evaluation of these calculations to verify their accuracy. Similar instances exist throughout the entire document for such things as load forecasts, effluent discharges into the air, and economic impacts with and without the OGS.

The importance of independent evaluation cannot be underestimated. For example, on pages VI-21 and VI-23 of the EIA issued by EPA, a 161 kV line is shown to proceed west from OGS to the Monroe County border and then northward to Poweshiek County where it connects to an existing 161 kV line just south of Searsboro. However, in the notices sent to landowners in Poweshiek, Mahaska and Wapello Counties by ISU on February 21, 1977, the most similar route was for a 345 kV line which was to proceed north from the OGS facility to Poweshiek County and then either west for about 2.3 miles before resuming a northern route or continuing due north, passing Montezuma on the west. Both the size and corridor locations are substantially different between the description provided by the EIA and that given in the February notice to affected landowners. This discrepancy was brought to EPA and ISU's attention by CARG in a September 22, 1977 letter to the two agencies. However, an independent evaluation by EPA would have uncovered this discrepancy in time to be corrected in the August 1977 EIA. Either EPA failed to conduct the independent evaluation which means that it is in violation of the CEQ guidelines and thus should not use the EIA as the draft EIS, or it did not cite the evaluations and reviews conducted and therefore is in violation of the "full disclosure" requirement of NEPA.

The final test to be met before it can be determined whether EPA may delegate the drafting of an EIS to ISU (and therefore utilize the EIA as the draft EIS required by NEPA) is whether such delegation is contrary to the responsibility of the agency. This issue has spawned substantial controversy which eventually led to the passage of Public Law 94-83 by Congress which amended NEPA to read, in part:

> "[An EIS] for any major Federal action funded under a program of grants to States shall not be deemed to be legally insufficient solely by reason of having been prepared by a State agency or official, if:
>
> "(i) the State agency or official has statewide jurisdiction and has the responsibility for such action,
>
> "(ii) the responsible Federal official furnishes guidance and participates in such preparation,
>
> "(iii) the responsible Federal official independently evaluates such statement prior to its approval and adoption, and
>
> "(iv) after January 1, 1976, the responsible Federal official provides early notification to, and solicits the views of, any other State or any Federal land management entity of any action or any alternative thereto which may have significant impacts upon such State or affected Federal land management entity and, if there is any disagreement on such impacts, prepares a written assessment of such impacts and views for incorporation into such detailed statement.
>
> The procedures in this subparagraph shall not relieve the Federal official of his responsibilities for the scope, objectivity, and content of the entire statement or of any other responsibility under this Act..."

The intent of Congress was to permit the delegation of an EIS preparation for "any major Federal action funded under a program of grants to States" provided that, among other things, the responsible Federal official "furnishes guidance and participates in such preparation" and "independently evaluates such statement prior to its approval and adoption." CARG notes that ISU is not a state agency nor is the OGS a project funded through a federal grant program. These facts alone are sufficient to require an EIS to be written independent of the EIA prepared by Black & Veatch on behalf of ISU. This is especially important inasmuch as EPA is a regulatory agency which must either approve, modify or deny an NPDES permit for OGS pursuant to section 402 as amended (PL 92-500).

EPA's regulatory function is an entirely different one than its function as a grant administrator for the construction of treatment works, a difference which must be recognized in its preparation of an EIS. CARG suggests, as the U.S. Court of Appeals for the District of Columbia urged the Federal Power Commission in Calvert Cliffs v. AEC, supra, that EPA review the procedures of the AEC, now the Nuclear Regulatory Commission. Those procedures also require the equivalent of an EIA from an applicant. However, a draft EIS is then prepared by the agency's staff and circulated for comment. In view of EPA's regulatory authority, a responsibility which requires greater discretion in its administrative decisionmaking, the OGS document circulated by EPA is improperly issued as an EIS. Even if EPA's decision to delegate the preparation of a draft EIS were upheld by the courts, the agency still fails to meet the criteria of guidance, participation and independent evaluation of the document prior to its approval and adoption as discussed previously in this section.

To correct the above deficiencies in the NEPA process CARG recommends that EPA, after correcting such deficiencies in making its own independent evaluation of OGS, issue a new EIS for comment. At a minimum the agency should consider issuing a supplemental draft EIS which adds the needed information outlined in this paper and which contains an analysis of the agency's evaluation.

III. GOAL OR PROJECT ORIENTED?

A. Conservation

Among the requirements of NEPA is the need to consider alternatives. 42 U.S.C. 4332 (2)(c)(iii) and 4332(2)(e). The Federal District Court in Environmental Defense Fund v. Corps of Engineers (Gilham Dam) 325 F. Supp. 728, 749, held that the range of alternatives which should be reviewed in an EIS included the rejection of a proposed action as well as alternatives that would fully accomplish the goal of the proposed action but would avoid the objectionable features. The Court in Sierra Club v. Froehlke stated, "it is not necessary that a particular alternative offer a complete solution to all technical, economic, and environmental considerations. If a portion of the original purpose of the project, or its reasonably logical subcomponent, may be accomplished by other means, then a significant portion of the environmental harm attendant to the project as originally conceived may be alleviated." 5 ERC 1033, 1069. In other words, a thorough discussion of every reasonable alternative must be made.

According to the Court in NRDC v. Morton, 337 F. Supp. 165 (D.DC., 1971), the analysis of alternatives to the proposed course of action should include a discussion of the environmental consequences of those alternatives. The intent of the law is to give the responsible federal agency the capability to select the appropriate course of action, whether the proposed project or one of its alternatives, in light of the net benefits and risks presented by each course of action. Further, NEPA does not contemplate that a decision to proceed with a project be made first and then an EIS be prepared as a technicality to fulfill the requirements of the law. Life of Land v. Brinegar (C.A. Hawaii 1973), 485 F. 2d 460, cert denied 94 S. Ct. 1979, 416 U.S. 961.

Within the context of the above caselaw, then, it is apparent that the NEPA review process is intended to be goal rather than project oriented. The Eighth Circuit Court in EDF v. Corps of Engineers (Gillham Dam) states that, in terms of legislative history, it is "clear" that NEPA is more than an environmental full disclosure law. 4 ERC 1721, 1725. Section 101 of the act, it said, established policies to guide agency action affecting the environment. Section 102 served to insure that the policies enunciated in Section 101 are carried out. "The unequivocal intent of NEPA is to require agencies to consider, and give effect to, the environmental goals, set forth in the Act, not just to file detailed impact studies which will fill governmental archives." (Emphasis added.) Id., at 1726.

In the case of OGS, EPA's goal of eliminating the discharge of pollutants into navigable waters by 1985, PL 92-500, Section 101(a)(1), is to be balanced against the apparent need for electrical power predicted by ISU. Thus the question EPA must ask is how can the need for electricity best be met while protecting the area's navigable waters?

Both ISU and EPA begin with the premise that a 727 megawatt electrical facility is necessary, a project-oriented assumption which becomes a self-serving assumption since a power plant of some type will be built. From there EPA and ISU justify the construction of a coal-fired facility since a) sufficient control technology is available to adequately reduce effluent discharge, b) economics and fuel availability favor the use of coal, and c) only a coal facility can be constructed in time to meet the expected demand by 1981 (this latter point is especially true since EPA has allowed ISU to begin construction of OGS before the completion of the EIS process, a fact which substantially prejudices the meaningful consideration of alternatives).

A goal-oriented approach to preparing an EIS would first verify the utility's projected load forecast using a methodology different from that used in the EIA.* Secondly, using data which identifies the need for power by sector, (e.g., residential, commercial, industrial, etc.) the EIS would determine whether other energy sources can be substituted economically for electrical use and if so, to what degree? Thirdly, the EIS would identify measures that can be taken to reduce expected demand either through programs developed by the utility, EPA, or other sectors. That such programs may be beyond the capability or authority of either ISU or EPA is not sufficient reason to omit discussion of their potential impacts from the EIS. See, for example, NRDC v. Morton (OCS), supra.

The DOI guidelines, supra, in its section entitled "No New Capacity Additions" state that "Practicable means which meet the projected power demand with adequate system reliability and which do not require the creation of additional generating capacity should be identified and evaluated. Such alternatives may include ...genuine conservation efforts. These conservation efforts may include publications, time-of-day pricing for peak and offpeak use, and inverted rate scales. Such alternatives should be analyzed in terms of costs, environmental impact adequacy, reliability, and other pertinent factors." DOI guidelines at p. A. 3-1.

The high degree of specificity called for in the DOI guidelines are replaced in the EIA with extremely vague discussions peppered with phrases such as "serious objections might develop," "indications are," and "It appears that conservation results have been general in nature." Only one reference to data is cited; the other reference listed discussed the Iowa Development Commission's "Youth Involvement Award." This is an amazing lack of detail considering that literally hundreds of reports and papers have been written on this topic in the last year alone.

It is not sufficient for the EIA to discuss isolated volunteer programs for conservation when the requirements for an EIS include a discussion of a) how much energy could be saved if the utility undertook a serious commitment to reducing electrical demand, b) how much money would need to be invested by the utility to save a kwh compared to investing it in a new facility, c) what effect a smaller construction program would have on stockholders earnings and on the economy, and finally, d) what the comparative environmental impacts would be.

CBRG suggests that detailed information be provided for the following programs which can be implemented by Iowa utilities:

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* This point will be more fully developed in a subsequent section of this paper.

1. Rate reform to reflect incremental cost of service
2. Load management and load controls
3. Insulation consultation and financing
4. Solar consultation and leasing
5. Industrial and commercial efficiency consultation
6. Co-generation
7. Interior environment consultation
8. Building Code revisions
9. Energy audit consultation
10. Recovery of energy from solid waste
11. Individual versus master-metering
12. Energy efficiency awards
13. Consumer usage information

After compiling this data, CARG believes the EPA should develop an alternative scenario based upon a strategy which combines the conservation impact of the thirteen items listed above and the construction of a smaller power plant. For example, if the combined impact of the thirteen conservation measures were shown to economically reduce overall consumption by 25%, the size of OGS could be reduced proportionately. The environmental and economic impacts of this scenario could then be compared with the proposed size of the facility. This would not be a mere academic exercise by EPA.

B. Conservation and the NPDES Permit

The objective of the Federal Water Pollution Control Act (FWPCA), as amended, is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." To achieve that objective, a national goal to eliminate the discharge of pollutants into navigable waters by 1985 has been established with an interim goal to be achieved by July 1, 1983 that would, wherever attainable, provide "for the protection and propagation of fish, shellfish, and wildlife and [provide] for recreation in and on the water." PL 92-500, Section 101(a), et seq. Traditionally the achievement of these goals has been largely through the use of control technologies, those devices which filter and clean water used, for example, in the cooling of a power plant before it is discharged into a river or stream. However, the reduction in the use of cooling water in power plants through increased emphasis on energy efficiency can make, perhaps, a greater contribution to the restoration and maintenance of the biological integrity of our waterways since saving a BTU creates comparatively fewer pollutants to be filtered than does producing a BTU. Thus, conservation can have a very real impact upon water quality.

Section 302 of the FWPCA states, in pertinent part:

> "Whenever, in the judgment of the Administrator, discharges of pollutants from a point source...would interfere with the attainment or maintenance of that water

> quality...effluent limitations (including alternative effluent control strategies) for such point source or sources shall be established which can reasonably be expected to contribute to the attainment or maintenance of such water quality."

If a conservation scenario clearly showed that the utility could meet expected demand with a smaller power plant, the Administrator, under a reasonable interpretation of his/her authority, could decide to issue a permit with effluent discharge standards which could be met only by a smaller power plant. This interpretation is particularly convincing in view of NEPA's mandate that "to the fullest extent possible...the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act." 42 U.S.C. 4332. At a minimum the Administrator could decide that although a permit must be issued for the larger power plant, its issuance would be conditioned upon the active participation by the utility in all or some of the 13 listed conservation programs earlier in this section. This would be justified as a necessary requirement to reduce future demand for water consumption and would, therefore, be an important step toward the 1985 goal of eliminating the discharge of pollutants into the country's navigable waters.

IV. FORECAST DATA DATED, INCOMLETE

Since the "need" for the OS hinges upon the estimates of "load growth projections" of the fourutilities involved in the project, section 1.02 of the EIA is pivoal inasmuch as this section apparently documents a significant shortfal in future electrical generating capacity without the power plan. To the extent that the projections are high, then the options of ether not constructing the facility or of building a smaller power plat, coupling its construction with an aggressive conservation program become feasible. CARG's review of section 1.02 finds that: 1) thedata offered is seriously out of date; 2) EPA has failed to verify anyof the projected forecast data and has also failed to identify specifi methodologies used to obtain the projections; and 3) the assumption made in discussing expected demand appear to be highly questionabl.

ISU relies heavily upon prjections presented by the Mid-Continent Area Reliability Co-ordinating greement (MARCA) which were offered to the Federal Power Commission onApril 1, 1976. Assuming that this data took a minimum of six months tocompile into the MARCA Report cited by ISU, the data is now over two yars old, an inadequate base of information upon which to approve a roject which may cost more than two billion dollars throughout its liftime. Since the collection of the information from utilities within the MARCA area, there have been substantial changes in both the Nationl and State Policies which potentially can affect the demand forecasts Nationally, Congress has enacted two significant pieces of legislatin -- the Energy Policy and Conservation

Act (December 22, 1975) and the Energy Conservation and Production Act (August 14, 1976). Congress is also completing work on President Carter's energy legislation. All three of these measures signal a substantial change in our energy policies; each should be identified as to content and potential impact upon expected consumption patterns.

Within Iowa there have been significant changes in legislation which may substantially alter Iowa's consumption rates. Prior to the 1974 session of the Iowa General Assembly, no legislation had even been introduced with regard to energy conservation. Since that time over two dozen separate bills have been filed. Among those measures adopted by the legislature three may have a substantial impact upon energy usage: a land use bill, an act providing the Iowa State Commerce Commission authority to evaluate future need of electrical power plants (note: OGS was exempted from the licensing provisions of the Commission bill), and finally, a bill authorizing minimum efficiency standards for buildings. Several other measures are pending. Each of these measures should be discussed, evaluating their collective and individual impacts upon Iowa's energy requirements.

There is little verification or analysis of data provided by EPA in the discussion of future electrical demand, a serious deficiency which needs to be corrected. For example, section 1.021 of the EIA states that "projections considered pertinent influencing factors such as energy conservation efforts, natural gas curtailments, and possible rate-usage pay structure changes." The EIA, at a minimum, should have mentioned how these factors were incorporated into what methodology and by whom. The claim is also made that the MARCA projections are "the most authoritative information concerning energy demand estimates presently available." The source of this judgment should be identified. As the District Court Judge in Sierra Club v. Froehlke, supra, noted, the EIS "should gather in one place the discussion of environmental impacts and alternatives so that it serves as a comprehensive document upon which responsible agency officials and others might rely in making the required balance between environmental and non-environmental factors." Again, by reference CARG incorporates the requirements listed on pages A.2-1 through A.2-4 of the DOI guidelines, supra, as the type of data and information necessary for an independent judgment to be made as to the projected need for a power plant.

As a further criticism of section 1.02, it appears as though some rather questionable assumptions were made in developing the growth projections. In section 1.021 the reference to "load growth projections" seems to imply that the resulting estimates of future demand are basically extrapolations of historic growth patterns similar to those types of projections that might be developed from an extrapolation of post-World War II trends, trends which may not accurately reflect current and future conditions. An example of how widely divergent growth projections might be (largely as a function of methodology), a study commissioned by the National Science Foundation found that the projections of the National Electric Reliability Councils (of which MARCA is one) greatly overestimated future demand. The study found that 1980 requirements would be approximately 2.2 trillion kilowatt hours compared to the estimate by the National Electrical Reliability Councils of 3.1 trillion kilowatt hours. See Electricity Demand: and the Clean Air Act, L.D. Chapman, et al., NSF, Oak Ridge National Laboratory, 1975.

A second illustration, one that is closer to home, also reinforces the possibility that the MARCA data may be overestimating future demand. During testimony presented by Iowa Power and Light Company, one of the four utilities with a share in the OGS project, in support of its request for rate relief pending before the Iowa State Commerce Commission, that company sought to justify its rate increase, in part, by showing that its ambitious construction program was necessary since it expected a growth in annual kilowatt hour sales of 7.3%. See generally the hearing transcript from ISCC Docket No. U-526, August 1976. It was brought out during the testimony of the company's president, Dwight Swanson, that Iowa Power based its growth projections only on past energy growth rates for the state of Iowa. This was then modified by an assumption that future energy growth rate for the state would be 25% less than past years because of "conservation factors" (unspecified) and the assumption that the traditional relationship between electrical growth and total energy growth would remain about 2 to 1 as in the past. See hearing transcript at page 1556. But assumptions cannot be considered proper substitutes for statistical and economic studies.

Company witness Hamilton, at transcript page 1773, admitted that the assumption of a 25% "conservation factor" was "judgmental." Moreover, the company's growth projections failed to consider any demographic studies other than population, made no analysis of land use plans, building and equipment use patterns and economic forecasts for its service area, and made no determination of how various rate designs would affect electrical consumption. Transcript at pages 1766-1772. These are the minimum inputs necessary before meaningful energy growth projections can be made with any degree of confidence. Inasmuch as MARCA projections rely upon data and forecasts generated by the individual utilities, it's likely that many of the forecasts contained in the EIA for the Ottumwa facility suffer from the same deficiencies.

Whether or not the NERC methodologies are more accurate than those utilized by Chapman and others is not the real issue here, although CARG believes this to be the case. The fact is that a real controversy remains and that EPA has failed to discuss and examine alternative methods of demand forecasting and should not, in good faith, proceed with further administrative action until this is corrected, a remedy which is consistent with NEPA's mandate that EPA fully evaluate all information in an EIA before it issues its own EIS.

Iowa Citizens for Environmental Quality

ICEQ

P.O. Box 1147 - Ames, Iowa 50010

Dr. Kathleen Camin
Regional Administrator
E.P.A.
1735 Baltimore Ave.
Kansas City, Mo., 64100

Dear Dr. Camin:

Please accept these comments submitted on the draft EIS of the Ottumwa Generating Station (EPA-907/9-77-004)

The comments on this EIS are similar to those made on the George Neal station in Sioux City dated in December 1976 with the additional visibility and reenforcement provided by the National Energy Plan which was released in May 1977.

sincerely yours

James J. O'Toole

James J. O'Toole
Acting chairman

The OGS EIS as in the case of the George Neal EIS does not demonstrate the need for Power based on econometric analytical projections and a program of appropriate conservation options.

No cost of Service Studies were presented to evaluate rate structures and possible restructuring to equalize costs thru the pricing mechanism and thus effect conservation practices. Additional options on pricing mechanisms i.e. "peak load" and "time of day" were not considered as conservation option.

The entire subject of rates was carefully avoided. As a result the public or interested individuals can made no judgement or raise pertinent questions concerning the disparity or relative economic efficiencies between industrial, commercial and residential, rates. This is a serious omission since the existing practice of declining block rate structures which is wide spread in the industry is recognized as inequitable and economically inefficient in the allocation of scarce resources becoming scarcer.

Perhaps the greatest single conservation program that can be initiated by the utility industry is one which is also prominent in the President's Energy Plan, that is cogeneration. The magnitude of this potential is evident in the statistics presented to the FEA by Thermo Electron Corp (TE 5429-97-76) in May 1976. The decrease in industrial cogeneration from 15% of all U.S. Energy use in the 1950's down to 4% at the present time reflects the effective marketing program of the utility industry, in large part due to the declining block rate philosophy. This situation is characterized by subsidization of large (industrial) user by small (residential) users in many cases where cost of service studies have been carried out.

Reversal of this situation may be stimulated by the President's Energy Plan to provide tax incentives but accelleration of this conservation tatic can be stimulated by 1) adjusting industrial rates to reflect true costs and 2) a survey by the utility, and educational program, in its service area, of industrial customers ripe for a cogeneration program with 3), capital input or loans possibly from the utility itself on a pay back program similar to the proposed home insulation program. The Thermo Electron study demonstrated that cogeneration in key high energy use industries (cement plants, etc.) would require less than half the fossil fuel input of the electric generating station and could produce the needed energy ~~for~~ at half the capital investment in a central power station.

The failure of the OGS EIS to address the conservation issue reflects a superficial and inadequate review of a very serious and urgent issue, one which is prominent in the National Energy Plan.

There does exist appropriate guidelines which can provide the EPA regional office with organized stepwise procedures in addressing the urgent but less established issues of market and demands for electric power. The U.S. Department of Interior publication 14-31-001-5238, NOV. 1976 provide one check list. A more important source is EPA's own Office of Federal Activities which is in the process of preparing guidelines for the preparation of environmental impact assessments on coal-fired power plants. Although this project is not complete the draft guidelines can be extremely valuable in addressing these issues mentioned above which have been omitted or inadequately treated in the OGS EIS.

The principal environmental issue which we see unresolved in the OGS EIS is the question of air emissions and scrubber technology. The emissions which will have only particulate control with no gaseous removal system will allow all SO_2 to escape. Although the emissions may conform to 1.6 lbs SO_2/million BTU the conclusion is moot and based on inadequate chemical data.

More importantly no cost/benefit analysis has been prepared to compare economic and environmental benefits from the best available control technology such as Venturi scrubbers as used in Colstrip units #'s 1 & 2 by the Montana Power Co. in Colstrip, Montana.

These important considerations are also needed to adequately respond to the emission problem.

1. Evaluation of impact required by NEPA not simply planning to meet existing air regulations. Some criticisms hold regarding vegetation damage as indicated in the George Neal comments from ICEO.

2. Air concentrations at ground level are inadequately treated by the dispersion model (Appendix E). Frequency of high ground level concentrations which result from "fumigation", "down wash", "plume looping" and "trapping" is not considered. The EPA models for short term dispersion, if employed, have not been discussed in the report.

3. Effects of terrain features on ground level concentrations should have been examined. The EPA model "TERRAIN" could have been employed.

4. The ineraction of the cooling tower condensate plume and the stack plume were not considered in evaluating the formation of acid mists and its effects.

5. The baseline evaluation program for air effects does not present data on the existing pollutant level in target species especially vegetation. Sulphur dioxide and fluorides both toxic to plants have not been analyzed in perennial vegetation within the most probable radii of high ground level concentrations. Neither has any consideration been given to establishing baseline levels for vegetation productivity to compare to post-operational impacts.

In considering the 1977 amendments to the Clear Air Act it is apparent that EPA is authorized to prohibit the use of western coal as a way in which utilities siting plants in other regions, could comply with implementation plans (see Environment Reporter Current Developments October 21, 1977 V8 #25 page 951). This option or requirement should be discussed. The entire relationship of the Ottumwa station's operation to the Iowa S.I.P. should be explained.

The technology proposed at the OGS also comes under severe review of the 1977 amendments as we are able to interpret them. We feel these considerations are major ones which require EPA's interpretation and explanation.

1) What now constitutes "significant deterioration" in Class II areas with respect to each pollutant

2) What consitutes best available control technology (BACT) under the new amendments. Will it be moe stringent than NSPS?

3) Under the new amendmens BACT reviews will include photochemical oxidants, nitrogen oxide and led. How will this be handled in the EIS process on OGS?

4) New requirements apply to sources which commenced construction on or after August 7, 1977. We assume officially that OGS has not commenced construction since this is the period of NEPA review, true?

In conclusion we feel that the issues surrounding the Clean Air Amendments combined with paucity of data on demands and marketing of power plus the notable lack of conservation alternatives is sufficient evidence for a reissue or supplemental Draft EIS and request that EPA consider this action.

ALTERNATIVES TO PLANT CONSTRUCTION

Under Sec. 102(c)(iii) of NEPA, the alternatives to the proposed project have not been adequately explored. This fact is emphasized in the description entitled, "Need for Power" starting on page I-9. Documentation for need does not appear in MARCA projections. Such documentation, to be valid, requires the support of econometric projection based on price/demand techniques of analysis which are well established. In general, electric utility marketing programs until recently have ignored these scientific techniques for projecting power demand, with the result that the mushrooming cost of power production has generated spiralling rate increases. These rapid sequences of rate hikes have resulted in decreasing electricity usage, consequent idle generating capacity and dramatic loss of investor confidence in the utility industry. Overcapacity and decreased earning in 1974 and 1975 led to a crisis. According to Bankers Trust Company of New York, "Probably no industry has come closer to the edge of financial disaster."

This dilemma within the industry has been the result of casual and inadequate demand projections based on historical extrapolations in a market that has changed dramatically. Since 1970 when the cost of electricity production stopped its downward trend, considerable increases in production costs due to rapid rises in the cost of installed kilowatt capacity combined with decreasing availability factors of newer large units, have harnessed utility customers with a legacy of debt for idle generating capacity. The present situation calls for a new pricing philosophy based on equitable and sound economic techniques of analysis. Applications of these techniques are nowhere in evidence in this Draft EIS of the Neal generating station. Basically, two major considerations need to be addressed.

1. Failure of historical pricing mechanisms to relay to the consumer through price signals the costs of his service on the basis of time and quantity of demand.

2. The failure to apply appropriate and established econometric techniques of price/demand analysis to project future demand, so critical to estimation of capacity needs.

Correction of the flaws in pricing mechanisms are being undertaken by many utilities, principally through orders from their state utility commissions (Wisconsin, Missouri, Vermont, New York, Michigan, Florida, etc.). These corrective actions are reflected in efforts to initiate marginal cost pricing and time of day pricing which in combination can convey accurate price signals and improve load balancing over short, intermediate and long run periods. To list these specific cases and techniques requires considerable space, but the options are well described in recent orders of the Wisconsin Public Service Commission and in the recorded testimony of Iowa Commerce Commission hearings of December 7, 1976. Excellent detailed testimoney by recognized rate economists are readily available (Charles J. Cicchetti in Pacific Gas & Electric Company application #54279 before the California Public Utilities Commission and in Madison Gas & Electric Company Docket #2-U-7423 of the Wisconsin Public Service Commission; also Fred J. Wells in Docket #U-1933 before the Arizona Commission on behalf of Tucson Public Power.) A brief report by J. Robert Malko, Chief Economist of the Wisconsin Public Service Commission (Public Utilities Fortnightly, July 15, 1976) is attached which describes the philosophy and feasibility of marginal cost pricing and time of use pricing now being initiated in Wisconsin.

Efficient load management cannot be achieved without accurate cost of service information and the fair allocation of those costs to the users creating the demand. The present declining block rate structure in general practice does just the opposite, it rewards the consumers creating peak demand through subsidies paid by off-peak users. Such rate structures did not appear inequitable when the cost and price of electricity were declining due to economies of scale and other efficiencies. Since 1970, however, the increasing costs of power have only emphasized the social inequities and economic fallacy of declining block rates.

Perhaps the most serious omission in the Neal EIS is the absence of justification supported by valid data which would lend credence to growth projections claimed. In particular, the three utilities (Iowa Public Service Company, Interstate Power Company and Northwest Iowa Power Cooperative) claiming the lion's share of the George Neal IV output disclose no information on cost of service or load analysis to support the need for the new station. Specific data are also lacking on the capital cost of George Neal IV, its anticipated capability factor and its impact on retail prices of electricity in the residential and industrial service sectors.

Such data voids cannot be explained away by claiming lack of information. In particular, the methods of forecasting demand based on the accepted procedures using economic models is by now a well-recognized technique in the industry. A study published in 1975 by the Federal Power Commission demonstrated that the projections of power consumption by the National Electric Reliability Councils for 1980 were about 40% too high when econometric demand analysis techniques were applied to each NERC. In particular, MARCA projections were 49% too high. A copy of the report, "Electricity Demand: Project Independence and the Clean Air Act", ORNL-NSF-EP-83 is attached. Overforecasting demand is a serious economic flaw, especially since debt retirement of today's new facilities accounts for roughly 75-80% of the average bill.

Exhibit A is a list of references describing applications and results of demand forecasting. We urge that these techniques be considered in developing an economically and socially acceptable procedure that can more accurately assess the need for George Neal IV.

The Neal Draft EIS does not adequately report upon nor discuss the data used as the basis for projecting demand in the MARCA and MAPP region as indicated in the EIS.

We anticipate that, to a large extent, the data necessary to accurate demand forecasting is in the files of the utilities but additional data may be required to apply the appropriate forecasting technique referred to in our Exhibit A. The data needed for this type of analysis is well expressed in the statement (Exhibit B) by Mr. Robert O. Marritz, executive director of the Missouri Basin Systems Group and in Exhibit C by Mr. Roy B. Hurlbut, utility specialist and energy adviser. These two exhibits are taken from testimony presented to the Iowa Commerce Commission at its hearing on December 7, 1976. We urge that the data needs described in these two statements be obtained and a re-evaluation of need for George Neal IV be made on the basis of professional econometric analysis. NEPA is very clear in emphasizing that all agencies "Utilize a systematic, interdisciplinary approach... in decision making."(102A) CEQ Guidelines (38 Fed Reg 20550-20562, 1973) express the responsibilities of Federal agencies to develop a "rigorous exploration and objective evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential." 1500.8(4). It is apparent that in the failure to treat the issues of demand forecasting and the application of marginal cost pricing and time of use pricing, viable alternatives, which might result in postponing or cancelling this economically and environmentally costly generating capacity, were precluded from consideration. We urge this omission be rectified in a supplemental draft EIS.

ENERGY CONSERVATION OPTIONS

The role of energy conservation has been ignored in the Neal EIS. Options to save energy in electric power consumption are many and varied. The environmental and health costs of fossil fuel combustion are well documented in EPA and CEQ publications. The political implications of energy saving have been emphasized in Project Independence reports and Federal Energy Administration literature. The economic burden in higher utility bills to consumers caused by the new George Neal IV station are not analyzed in relation to the potential savings to be gained from conservation techniques. It is obvious that any program of conservation requires some investment. What is needed in this case is a Cost/Benefit analysis of alternatives which in fact are called for under CEQ guidelines.

Conservation measures should be considered in two general ways: (1) greater efficiencies at the same level of consumption, and (2) modifications of technology and/or practice which decrease total energy consumption.

The first approach can be achieved through load balancing and full substitution. Load balancing had been effectively demonstrated in peak load pricing techniques in Vermont and is now underway in Wisconsin and planned by several other states. Pennsylvania Electric Company simply through a publicity campaign aimed at reducing residential peaks, realized a

22% improvement with a $700,000 saving. Fuel substitution using the more efficient fossil fuels for hot water and space heating as opposed to electric is capable of reducing peaks as well as total use.

Information on appliance efficiency is a valuable help in consumer selection of high wattage units. Air conditioners are a prime target since they create the summer peaks in midwest residential demand. A study of a Missouri service area showed that replacing all air conditioners of low efficiency with the most efficient models available would be a cheaper option than building the power plant required to meet the rising demand created by the old air conditioner peak.

Such options for conservation should be analyzed on a cost/benefit basis of KW of demand saved vs newly installed generation capacity. The response of industrial customers in Iowa to load management programs is proved by the successful test run by IPALCO to reduce load of 15 large consumers in the summer of 1975. The projected periods of high demand were relayed to the cusomters who were given credit for reducing their demand. Peak power was reduced by 3521 KW at a cost of $10,563 in credits. Contrast this to an installed cost of $800/kw which would require a capital investment of 2.8 million dollars. In summary, we urge that conservation alternatives be initiated and developed under guidelines of the Energy Conservation Act of 1976 and the assistance of other Federal, state and private parties as directed under NEPA and CEQ Guidelines. The alternative of "Not Providing Power", p. VI of the EIS, is a wholly inadequate statement in addressing the alternatives contained in para. 102(c)2(iii) of NEPA.

AIR EMISSIONS

In estimating air emissions, first order consideration is coal composition. In the EIS, p. II-3, the presently operating Neal Units 1-3 are described as using Hanna Wyoming coal with an average sulfur content of 0.6%. This coal created an emission rate of 1.3 lb/mB which is permissible for old sources but would not be for new sources. Over on p. IV 56 an inconsistency appears when the typical S content is said to be 0.32%. This, we presume, is the same Wyoming coal source. Such casual use of analytical data is unacceptable for several reasons.

1. Sufficient replicates of coal should be analyzed to provide a variance and confidence level of analysis.

2. Coal should be sampled in the prescribed manner throughout the seam and throughout the seam face in order to provide a measure of the variance of the chemical constituents due to the naturally occurring compositional differences. Adequate chemical data have been reported on Western coals to demonstrate large naturally occurring chemical variances within a seam on both vertical and horizontal axes. In the case of sulfur, this variance can be threefold. It is therefore possible for George Neal IV to exceed Federal emission standards for extended periods when higher sulfur areas are encountered. Unless more definitive evidence is presented to assure compliance, we urge scrubbers be installed.

The emission of minor constituents released either as a gas or particle has not been treated adequately. The toxicity of many of these elements is well known, e.g., the heavy metals Pb, Cd, As, Se, Hg, etc., and the lighter elements Be and F. The mass balance of these elements through the plant should be considered in detail. There is a sequestration process taking place in all coal-fired plants. Some elements are found enriched in bottom ash while some are enriched in stack gases and fly ash. The trend for many toxic elements to become enriched in the small particulate size (.1 to 1 micron) of fly ash poses respiratory threats since they reach the lung alveoli. Even though these particulate releases may meet emission standards, they add to air shed loads since they are capable of being transported large distances. These incremental pollutant loads added to urban air sheds should be discussed in relationship to the findings of EPA's CHESS report. Such factors also should be considered on a Cost/Benefit basis.

Of these minor elements, fluorine poses a very great threat to vegetation. It is 100 to 1000 times as toxic as sulfur dioxide and the sulfur/fluorine ratio in Western coal makes fluorine a greater threat to sensitive native and agricultural plant species than sulfur. The phytotoxic effects of fluorine were discussed by Gordon et al. at the American Chemical Society Symposium on Fluorine Compounds in the Environment, 8/31/76 at San Francisco, California. We urge that direct data on fluorine concentrations in the air and environment of George Neal units 1-3 be determined. The environmental sampling program reported by Gordon in Montana showed fluorine accumulation and significant pathology to native vegetation in the vicinity of a 180 MW power plant burning Rosebud seam coal, a "typical" Western low sulfur coal. The impact of 1573 MW of George Neal 1-4, by comparison, approaches an order of magnitude greater threat.

EIS p. IV-63, Effects on Terrestrial Biota

This section, which deals with potential impacts of very significant economic importance, is deficient in addressing the known scientific facts about sulfur dioxide pollution. It also attempts in the opening paragraph to place this serious plant toxin in a favorable light by suggesting a minor and debatable benefit. Indeed, the fact that leaf stomata take up SO_2 is the principal explanation for the first step in the toxicity chain of events.

The conclusion on p. IV 63, "it appears unlikely that the predictable maximum annual concentrations from George Neal Units 1-4 will injure flora of the site and surrounding region" is made in the face of scientific evidence to the contrary. Much is made of the data projected from diffusion modelling which would support the hypothesis that emissions from all four units will meet ambient and emission regulations. In the first place, we believe that these projections are inadequate substitution for sufficient field observations which should have been underway at sites 1-3 and carried out in a more purposeful scientific design. Even dismissing this criticism, however, the facts under consideration in the NEPA process are not simply compliance with regulations, but the estimation of any impact this project will produce irrespective of regulations. The following observations amplify the impacts of sulfur dioxide and emphasize the omissions of these important data in the draft EIS.

1. The sensitivity of economically important crops in this area, corn and beans, has been demonstrated in controlled experiments at SO_2 levels well below even secondary standards. In 1966-7, the National Air Pollution Control Administration carried out greenhouse studies in Kansas City on sensitive plant species including corn and beans. The experimental plots were grown in an atmosphere whose SO_2 levels during the growing season were below Federal ambient standards. Nevertheless, plant growth was suppressed 25-50% compared with controls.

2. Serious fumigation episodes at Mount Storm, West Virginia in 1972 and Kyger Creek, West Virginia in 1973 caused extreme foliar damage. In July of 1971 and twice during 1974, the plume of the TVA 1750 MW Shawnee plant fumigated at acute levels affecting 26,400 acres of soybeans in 1971 and 41,800 of vegetation in 1974. EPA representatives made field observations during these episodes and a full description including the potential for similar impacts at the George Neal site should be presented. In addition, the comments of Dr. Clarence C. Gordon, Plant Pathologist, University of Montana, Missoula, who investigated and reported on these episodes, should be sought.

3. The National Environmental Research Laboratory of EPA has been conducting Zonal Air Pollution research with SO_2 at their Montana study site. Results of these studies should be obtained and the data, where possible, used in evaluating vegetative impacts at the George Neal site.

4. The section on acid rain (EIS, p. IV-67) is a vague and incomplete description of the scientific knowledge and true impacts of acid rain. Since 1952, European investigators have carried out precipitation chemistry studies throughout western Europe. These studies, which are reported in over 100 scientific articles, demonstrate rather vividly that acid rain primarily caused by atmospheric emissions of the industries of Germany, France, and England have caused in the past and are currently causing a serious impact upon the aquatic and terrestrial ecosystems of Norway and Sweden. A condensed version of what is currently knownabout acid precipitation and its effect on ecosystems can be found in a 1976 USDA 1,074-page publication (Technical Report NE-23), "Proceedings of the First International Symposium on Acid Precipitation and the Forest Ecosystem." It is imperative

that the EIS writers obtain this publication and attempt to relate the known data to the potential SO_2 and NO_2 emissions to be released from stacks of George Neal units 1-4. In amplifying further the specific impacts on plants of acid rain, we suggest the report of Gordon in "Proceedings of Fort Union Coal Field Symposium 4/25-26/75" at Eastern Montana College, Billings, be reviewed. Also important is Gordon's testimony before the Montana Energy Siting Board in 1974-75. The need for a rainwater monitoring program to determine the acid rain potential of the currently operating George Neal Units 1-3 is essential. It should have been initiated at least by the Spring of 1976 when NEPA procedures began to be applied. The entire on-site monitoring program for providing needed data on the phytotoxic pollutants is inadequate. We urge that steps be taken to design a program that will provide sufficient data to establish a benefit/cost analysis on potential economic impacts to agricultural crops resulting from the George Neal complex.

The effects of air pollutants on higher animals starting on p. IV 69 of the draft EIS omits impacts on man. Perhaps the reasoning here is that the primary ambient air regulations of the Clean Air Act cover adequately such impacts. In our interpretation of NEPA, such is not the case. CEQ guidelines emphasize the importance of detailed considerations of all impacts. In the case of the George Neal plume, the annual loads of pollutants released are huge and may increase. The ultimate fate of these pollutants, SO_2, F, NO_x particulates with toxic trace elements, have to be evaluated carefully and their potential effects discussed. These pollutants in part are deposited locally, yet the bulk of all are transported considerable distances off site. They may be ultimately precipitated by wet and dry deposition processes, arriving at target sites which may be highly sensitive or refractory. At any rate, they contribute to pollutant loads in adjoining air sheds and such incremental threats to human health, biota, and materials are not insignificant by any means. These effects should be evaluated. The atmospheric modelling and Benefit/Cost analysis technique of EPA are capable of providing such information. Such concepts are already incorporated into the non point source philosophy. Through these and the previously cited considerations, the provision of NEPA can receive the substantive response it demands and the ultimate best alternative rationally adopted.

James J. O'Toole

James J. O'Toole
Acting Chairman
Iowa Confederation of
Environmental Organizations

WAPELLO COUNTY CONSERVATION BOARD

BOARD MEMBERS:

Bill Reed...........Chairman
Verle Handy.........Secretary
Raymond Coughlin....Vice Chairman
James Mc Donald.....Member
John Underwood......Member

EXECUTIVE OFFICER:

John E. Stuart
1631 Greenwood Dr.
Ottumwa, Iowa 52501
Phone 515-682-7346

October 26, 1977

U. S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64180

To whom it may concern:

The following comments are made in the sincere hope that they will be considered with the same care and thought with which they were made.

Summary: Page ii, subsection 5.

The Wapello County Conservation Board wishes to express its disappointment at the apparent oversite of the agency involved in drafting this Draft Environmental Impact Statement in failing to seek comment from this Board.

Chapter 111A of the Code of Iowa is the enabling legislation for the Wapello County Conservation Board. Section 111A.1 of that chapter states, "The purposes of chapter are to create a county conservation board and to authorize counties to acquire, develop, maintain, and make available to the inhabitants of the county, public museums, parks, preserves, parkways, playgrounds, recreational centers, county forests, wildlife and other conservation areas and to promote and preserve the health and general welfare of the people, to encourage the orderly development and conservation of natural resources, and to cultivate good citizenship by providing adaquate programs of public recreation."

It is the express opinion of this Board that the Ottumwa Generating Station will certainly have some effect on the natural resources of Wapello county and it is for that reason that further comment will be made.

Section I. Project Description, Paragraph 1.04511

No mention is made of the pollutants that will be mixed with the rainfall runoff from the coal storage area nor does there appear to be any plans for treatment of this water. Instead these waters are to be discharged into the Des Moines River via an underground siphon. There is no suggestion of a study to determine the effects these pollutants will have on the aquatic ecosystem of the area or the terrestrial inhabitants. Nor is there any mention of the effects of such pollutants on the water purification system of the city of Ottumwa.

Paragraph, 1.048 Fuel Supply, Transportation, and Utilization

We find it very disquieting to find that no contracts have been signed to assure the use of low sulfur Wyoming coal. At a public hearing held on this E. I. S., officals of Iowa Southern Utilities, assured us that Wyoming coal would be used however we see no concrete evidence of this in the E. I. S. which leaves the door open to a change in fuels, i.e., high sulfur coal.

Paragraph, 1.0483

What effect to the air quality will dust from the coal crushing activity have? Furthermore what effect will this dust have on the water quality of the Des Moines River, the surrounding plant life, and the workers involved in this activity?

Section IV Environmental Impacts of Plant Construction
Paragraph, 4.0111 General

"Were this a natural, or near natural area, these impacts would be severe indeed, and difficult to justify. However, the impact of the plant relative to the degree of environmental dissruption already present on the site reduces the severity of the impact of the facility."...

We find this statement to be, at best, arrogant. We feel it would be hard to achieve a more severe impact on the area and its inhabitants than to completely destroy the surrounding habitat.

It appears that the author of the statement has neglected the benefits to wildlife, the people of the area, state, and world, of the agricultural practices of the area, such as food shelter and concealment. These benefits are not short-termed either, the problems of world hunger will exist far beyond the thirty year life of the O. G. S. and the loss of 790 acres of crop land is far more critical to this problem than is the construction of this facility.

Paragraph 4.0112 Impacts on Vegetation

According to this section there will be a loss of only five acres of vegetation. No mention is made of the remaining 790 acres of crop land or the far reaching effect of its loss. We refer you to the preceding comments made on this subject and ask if we can afford the permanent loss of this much land? We would also refer you back to page two of the glossary in this E. I. S. and the definitions of "ecosystem" and "environment", of which these lands are a part.

Section VII Relationships Between Short-Term Uses Of Man's Environment and Maintenance, and Enhancement of Long-Term Productivity.

This title is long, precise, and involved, and would lead the unexpecting reader to expect a lengthy and detailed discussion of the subject. Unfortunately this is not the case, instead the reader is presented a short, shallow discussion having no correlation to the title or subject matter whatsoever.

The major problem with the short-term benefits is that they are short-term. What is to become of the facility after its useful life of thirty years is realized? There is no discussion of the inevitable obsolescence of this plant and what or how its closing will effect the area sociologically, economically, and/or environmentaly. Is it to be left to rot and rust creating an eyesore on the landscape when its usefulness is out lived?

In paragraph 7.01 the life of the OGS is termed "...short-term..." yet in paragraph 7.022 it is sited as,"...an increase in human productivity stimulated by the availability of additional electric power."..., a significant long-term effect. Which are we to believe, when does short-term become long-term; apparently when it serves the needs of the owners of the OGS.

Apendix:

Examination of the data contained in tables C-1 and C-2 will show that some species will be affected, minimaly; moderately,local population depression; moderately detrimental; or "present status or no apparent impact". The first question that comes to mind is, what do these terms mean? Next by what standards were these definitions assigned? ✓

Further examination will show that 18% of the terrestrial species occurring in the site area will be effected by a "moderate, local population depression", and that 86% of the avain species occurring in the site area will experience a "moderately detrimental" effect caused by the OGS.

When one combines these data they will find that 78.6% of the combined species will suffer a "moderate, local population depression/moderately detrimental" effect form the OGS, a figure which we find to be alarming.

The Wapello County Conservation Board would like to express its appreciation for the opportunity to respond to this Draft Environmental Impact Statement and are anxiously awaiting the outcome of the final statement,and hope that the final statement will adopt some type of definitive stand on the issue.

Sincerely,

John E. Stuart

John E. Stuart
Executive Officer

P.S. I would further like to express my appreciation for the phone call of 10-27-77 from your office informing me of the deadline extension. Thank you very much,

J.E.S.

October 26,1977
Cherry Hill, N.J.

Ms. Mary Jeanne O'Donnell
Environmental Protection Agency
1735 Baltimore Avenue
Kansas City, Missouri 64108

Dear Ms. O'Donnell:

As one of the landowners whose property is affected by the proposed route of electrical transmission lines to the Ottumwa Generating Station, Ottumwa, Iowa, I am writing to you to protest this action. The farm in question is located north of Ottumwa in Wapello County; it has been in our family for four generations and was homesteaded by my great-grandfather. This is prime agricultural land producing excellent quality crops, i.e., corn and beans, in great abundance. Currently this land is valued at $2,000 - $2,500 per acre.

My reasons for opposing the proposed route are:
(1) In my opinion it is poor judgement to condemn excellent farm land for the construction of the transmission line when alternate routes exist in land which is not under cultivation. Utilization of Des Moines River land or the railroad right-of-way would be more feasible.

(2) Since no one really knows the precise and/or long term effects of magnetic fields induced by high voltage lines upon human or animal life, it goes without saying that such lines should not run through inhabited areas - if at all possible.

(3) Farm operations are hampered; operation of large farm equipment is very difficult around the pylons supporting the transmission lines. Aerial spraying and dusting operations would be impossible.

(4) The easement for a 100 ft. strip of land across the property lessens the desirability of the farm and diminishes its value.

In addition the manner in which these proceedings have been undertaken are devious and irritating. In June, 1976 (ten months before the hearings before the Iowa State Commerce Commission.) I was approached by a representative of ISU about the easement for the transmission line; at that time he contacted my lawyer in Ottumwa and also talked at length with me, via long distance telephone, attempting to persuade me to accept an offer of $3,200 for the 100 ft. strip of land. I rejected this offer expressing my opposition to the proposal at that time; whereupon he attempted to psychologically coerce me by stating that opposition to ISU plans was futile that the Iowa State Commerce Commission would rule in the company's favor and subsequently the land would be condemned. Yesterday, October 24th, I received another proposal from one Richard L. Paze, Right of Way Agent from ISU, offering $4,500 for the same 100 ft. strip of land. In my view these feeble attempts amount to little more than bribery. The role of ISU in this transaction seems to me to be a classic example of the exploitation of the individual by a large corporation or near monopoly.

Sincerely yours,

Jean Dimmitt Sedar

Jean Dimmitt Sedar
113 Granville Drive
Cherry Hill, N.J.
08034

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ROBERT J. SPAYDE
JAMES P. RIELLY

EDDYVILLE, IOWA
FRIDAY AFTERNOONS
THIRD & WALNUT STREETS

October 18, 1977

U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Attention: Mary Jean O Donnell

Dear Ms. O Donnell:

This letter is being written by this writer as Attorney for Tri-County Agricultural Property Rights Association, a non-profit corporation which is duly organized under the laws of the State of Iowa, which represents approximately 300 persons who are affected by the construction of the Ottumwa Generating Station by the Iowa Southern Utilities Company and more particularly by the system of transmission lines which are being proposed to serve this facility. You will perhaps recall this writer appeared with the officers of this organization at the meeting which was held at Ottumwa, Iowa, on the 28th of September, 1977.

On behalf of the owners of agricultural real estate and the tenants who farm such real estate we would like to urge the Environmental Protection Agency to give very strong consideration to the adverse effect that the construction of this plant and the construction of the transmission lines which would serve this plant will have upon the environment of the people of Poweshiek, Mahaska, and Wapello County Counties in the State of Iowa.

It is the position of our organization that permits should not be granted by the Federal Government with regard to this plant for the reason that there has been no need demonstrated for the construction of another generating facility in this area. At the present time the Congress is working on the Energy Policy which will be developed for many years to come. We think it is premature to grant and authorize a permit which will affect our environment with regard to this generating plant until such time as we are aware of what the future

Energy Policy of this country will be. It may well be it is not necessary to construct this plant, which will have an adverse effect upon our environment if the policy shows that the energy needs are not that great.

With regard to the effect of the transmission lines on agricultural real estate, we believe that the proposed draft environmental statement which was circulated and which was discussed at the meeting of September 28, 1977, it is highly misleading in that in paragraph 6.08218 it is stated "intensively cultivated areas will be avoided". This statement is absolutely false! On the plat which appears on the opposite side of the page from that quotation, being plat VI-21 there is shown a proposed transmission line on which Iowa Southern Utilities Company has had hearings before the Iowa Commerce Commission and which they have obtained the right of eminent domain. It is submitted that this transmission line goes directly through some of the finest agricultural land in the world. To substantiate this position we would call to your attention the fact that there are approximately nineteen court cases pending in Mahaska County District Court and the Mahaska County Court House is located in Oskaloosa, Iowa. A review of these cases will show that the condemnation jury which is composed of real estate persons who are knowledgeable and who are experts in the area of valuation have awarded agricultural property owners and their tenants substantial damages for the condemnation of their land to put the tramsnsmission lines through Mahaska County. All of these awards which are substantial have been appealed to Mahaska County District Court by the Iowa Southern Utilities Company, who does not want to pay the amounts that the condemnation jury awarded in their deliberations. This is why these cases are now pending in Mahaska County District Court. A review of these awards will show that one Jacquelyn R. Mick was awarded $4500; Pierson Seed Producers $6500; Homer Hasselman $5,000; Cliffton Smith and his son Marvin Smith were awarded a total of $12,500; Lawrence Everett and his brother, Frederick Everett were awarded a total of $19,000; Marion Franje was awarded $42,000; Irene Weber was awarded $15,000; Howard LaRue was awarded $8,200 and Merle Van Steenis was awarded $14,000. These figures are very dramatic and show without question that Iowa Southern Utilities Company is causing a greal deal of damage to intensely cultivated areas and the experts who were on the condemnation commission recognized the extent of these damages. It is respectfully submitted that these figures are the best of evidence to show that there is a devastating impact on prime agricultural land in Mahaska County because of the proposed construction of the transmission lines of this plant.

It is further submitted that with regard to the informational hearings that were held at William Penn College in February, 1977, with regard to another proposed route which would run to the east of the route shown in the Environmental Impact statement, that that proposed route would be even more devastating to prime agricultural land than that which has already been condemned through the proceedings before the Iowa Commerce Comission. Some of the persons that would be affected by that proposed route would be endangered by having a high voltage line very close to important improvements which would endanger the lives of the persons living in the area. We have had in this area a number of very serious personal injuries as a result of high voltage line wires where contact has been made with grain elevators and that type of equipment as well as a number of deaths. It is the concern of the people of this area that we should not be subjected to any more health hazards than we have at the present time. It is submitted that there has been insufficient research and testing as to the affect on the lives of the people who are required to live in the close proximity to high voltage lines. We do not believe that the fears in this area are any different than those of persons living in other parts of the country. The CBS program "60 Minutes" which ran a Documentary on the great deal of controversy that has risen in the State of Minnesota where a high voltage line is being proposed is an example. That program greatly dramatized the feeling of everyone who is subjected to this type of treatment. There is a genuine fear not only of the damage to the property that will result from the construction of these high voltage transmission lines but from the danger of personal injury and death that may result from having them placed in our environment. Two of the very significant points that were made on the "60 Minutes" program which was shown on "CBS" on the 9th of October, 1977, was the statements made by one person to the effect that there is substantial evidence that these high voltage lines do in fact have a serious effect upon animal life and since the members of our non-profit corporation are primarily livestock farmers it is submitted that having these transmission lines over their property into the indefinite future will have a serious impact on their operations. Also it was important to note that in the "60 Minutes" program that it was pointed out that the people of this country are being subjected to an erosion of their private rights by the actions of the big power companies in moving in and taking over and disregarding the rights of private property.

It is further submitted that if it is deemed necessary to have transmission lines constructed in the three counties above referred to that there are alternative routes available which could run along railroad right-of-ways, along public roads and through non-productive agricultural land which could be used for the transmission line construction and if these alternate routes were selected it would reduce the serious impact on prime agricultural land. The members of this corporation do not understand why these transmission lines could not be erected along the right of way of interstate highways where there is a very wide area from the shoulder of the road over to the abutting property.

With regard to the devaluation of farm land by the existence of the transmission lines across prime agricultural land, I would like to pass on to you the opinion of one client who is involved in a transmission line for which Iowa Southern has already obtained franchises. This person owns a 260 acre farm and with the way the power line would be placed across his land he has reached the conclusion that it would devalue his land by at least $200 per acre. On a 260 acre farm this would be a devaluation of in the sum of $52,000. With the dramatic increase in the value of farm land in the State of Iowa in the last seven years, this type of devaluation will become more dramatic in the future if the inflation in agricultual real estate continues. This devaluation is caused by many factors. In modern agriculture with larger units big equipment is necessary to farm efficiently. It is extremely difficult to farm around a transmission line tower using the large equipment. It is also submitted that where these power lines exist, it is extremely dangerous and probably impossible to spray agricultural crops in the vicinity of the towers. Also these towers would greatly hinder irrigation projects which are starting to become more popular and more necessary in light of the drought conditions which we have experienced in the State of Iowa, and what is most important to realize in connection with the erection of these transmission lines is that they are permanent fixtures which will be a problem for the farmer for many, many generations to come, and if you accumulate these damages that are sustained on an annual basis a person would have a very substantial amount of damage over his lifetime as the result of having to farm around the transmission towers.

It has been mentioned by some of the members of our organization that consideration should be given to requiring power companies to bury this type of construction in the ground so that it will not have the adverse effect on the environment that it now has. Also a number of members of our organization feel that the whole condemnation procedure of awarding damages on a one shot basis is unfair. It is submitted that if this type of acquisition is allowed by the big power companies that they should be required at least on a periodic basis of, for instance ten years, to have to pay damages on a periodic basis, and not be able to secure these valuable rights by payment of a one time figure.

It should be noted that paragraph 1.0446 of the impact statement states:

"Consumptive water use is that water that evaporates or is used and not returned to the Des Moines River, Cooling tower losses to evaporation and drift are 10,028,000 gpd as a maximum and 7,026,000 gpd on an average. Maximum and average consumptive use in the bottom ash system is 288,000 gpd and 202,000 gpd, respectively. Losses in the steam cycle due to soot blowing and steam loss are 80,000 gpd maximum and 64,000 gpd average (see Table 1-5)."

It is submitted that the Des Moines River in the summer of 1977 had very low flow and would not have been capable of even furnishing a portion of the water required by these demands.

At the hearing in Ottumwa it was pointed out that 17 cubic feet of water per second would be withdrawn from the Des Moines River and only 1.4 cubic feet per second would be returned to the river. It is our understanding that the water would be turned into steam and the farmers in this area are very much concerned about the atmospheric conditions which will result from this type of activity. It is further submitted that the quality of the water that is being returned to the river after having gone through the generating facility will have a very detrimental effect on the fish in the river as well as the quality of the water below the generating facility. We do not think that the State of Iowa needs to have its environment further spoiled by this type of generating facility.

One of the great concerns that the people of our organization as well as all of the other citizens of this country had is the great concentration of power that is being exercised by the big utility companies in this country. We have in this situation a good example of an arrogant display of power on the part of Iowa Southern Utilities Company. It is undisputed that they have spent millions of dollars without securing the required permits from the Federal Government and they also expended millions of dollars before they secured the requirement for an air quality permit from the State of Iowa. We do not believe this should be permitted because the expenditure of such substantial sums of money is bound to influence and prejudice the decision of independent agencies of the government should be able to make on an objective basis. If millions of dollars of consumers money has been spent it is likely to influence the decision of an administrative agency to go ahead and allow the permits to be issued, because there is a natural tendency on the part of administrative agencies not to want to see consumers money squandered by waste. We think that this type of activity should be halted,and an example should be made of Iowa Southern Utilities Company in this instance. These expenditures should not influence the decision of the Environmental Protection Agency in determining whether these permits should be issued. In conclusion we would like to reiterate the comments that we made at the public meeting in Ottumwa on the 28th of September, 1977. As we there stated,the people of this country are greatly frustated by the feeling that we as individuals are being overpowered by the big utility companies and special interest groups in this country. It is because of this trend that agencies like the Environmental Protection Agency have been created by Congress to protect the people of this country from such encroachments. We hope that in the instant case that you will carefully consider all of the arguments that we have made as well as the other technical data and in the end come down with a decision that will be in the interests of all of the people of the State of Iowa.

SPAYDE & RIELLY

By ______________________
James P. Rielly

Attorney for Tri-County
Agricultural Rights Association

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CHARLES M. KIPLE
J. TERRENCE DENEFE

AREA CODE 515
TELEPHONE 683-1626

Oct. 31, 1977

Ms. Mary Jeanne O'Donnell
Environmental Impact Study Preparation
U. S. Environmental Protection Agency
1735 Baltimore
Kansas City, Mo. 64108

Re: Ottumwa Generating Station,
Iowa Southern Utilities Co.
Environmental Impact Study

Dear Ms. O'Donnell:

At the time of this writing, I have before me the letter of Oct. 7, 1977 to you from Mr. Charles M. Kiple of this office. As indicated in Mr. Kiple's letter, he represents 51 property owners in connection with their objections to construction of a 161,000 volt transmission line as proposed by the Iowa Southern Utilities Co. from the Ottumwa Generating Station for which the Environmental Impact Study is now being prepared. Mr. Kiple's clients are all concerned about the proposed "North route" from the present Wapello County Substation to the new Ottumwa Generating Substation near Chillicothe, Iowa.

I am representing 49 property owners on the proposed "South route" from the Wapello County Substation to the Ottumwa Generating Station near Chillicothe, Iowa. Each of my clients are either farm owners, operators or living in rural residential areas that are affected by the transmission line in question.

It is also my understanding that the Environmental Impact Study states that "where possible, the right of way will be confined to areas devoted to timber and pasture land use. Intensely cultivated land will be avoided. Wherever possible structures will be located in fences or in wasteland." However, the proposed "South route" does not consist of mainly timber and pasture land. The proposed "South route" crosses through intensely cultivated agricultural land, highly populated rural areas, and some rural areas which are highly commercial or industrial in nature. On behalf of my clients I submit that there are other alternative routes available to the Iowa Southern Utilities Co. which would be more suitable when the impact on the environmental quality of the affected area is considered. My clients contend that the Iowa Southern Utilities Co. should run the proposed "South route" along either the Rock Island Railroad right-of-way or the Burlington-Northern Railroad right-of-way. I am confident that Mr. Kiple's letter of Oct. 7, 1977 adequately sets forth reasons why this should be done in lieu of the proposed "South route".

If you would have any questions concerning any of this, please advise and I would be happy to discuss this with you. Thank you.

Very truly yours,

KIPLE & KIPLE

By
J. Terrence Denefe

JTD:ev

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 77/767

OCT 13 1977

Mr. Charles V. Wright
Acting Regional Administrator
Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64102

Dear Mr. Wright:

Thank you for your letter of August 10, 1977, transmitting copies of the Environmental Protection Agency's draft environmental impact statement for the Ottumwa Generating Station, Wapello County, Iowa.

Our comments are presented according to the format of the statement or by subject.

Fish and Wildlife

We are unable to ascertain what the effects of the station will be on terrestrial wildlife populations. The project boundary will include 795 acres. The 1975 land use was identified as being 301 acres of corn, 147 acres of soybeans, 88 acres of hay and 259 acres of pasture woodlands. Page IV-1 states that there will be a loss of about 3 acres of forest and 2 acres of grassland. Page IV-48 states that 77 acres of corn and 45 acres of soybeans will remain during the operating life of the Ottumwa Generating Station. Page IV-26 states that "after station operation begins, most of the site will be covered by native grasses, shrubs and trees." However, we were unable to ascertain the acreage which will be used in the operation of the station for coal storage, ash ponds, parking, generating station, etc. The acreage utilized for physical features of the station should be identified. The final statement should state the expected acreage to be covered by native grasses, shrubs and trees and if it will be subjected to grazing or if it could be managed to mitigate unavoidable wildlife impacts.

CONSERVE AMERICA'S ENERGY

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Page IV-36 states that the intake structure is designed for an intake screen velocity of 1.0 fps at a low elevation of 639 feet MSL and approximately 0.8 fps at a normal elevation of 648 feet MSL. The Fish and Wildlife Service currently recommends that intake screen velocity be in the range of 0.30 to 0.50 fps to minimize the loss of small fishes. The final statement should indicate at what distance from the screens the approach velocities were measured.

The discussion of transmission lines on page VI-19 does not indicate whether the transmission lines and towers are designed to prevent raptor electrocution. This should be further addressed in the final statement since proper design can eliminate this problem.

Water Bodies on the Plant Site

The draft statement on page II-81, should include a history of flooding on Avery Creek. This information is especially needed since it is pointed out on page II-82 that the creek contains several log jams and brush piles at its confluence with the river.

Water Quality

It is noted on page IV-28, that discharge to the Des Moines River from the ash pond will be minimal except during periods of high precipitation. Monitoring should be considered on the river upstream from Avery Creek to evaluate any adverse effects on the water-quality of the river that may result from ash-pond discharge, particularly during periods of high precipitation. This monitoring program should be correlated with the current water quality studies discussed on page II-70.

Ground Water

On page II-26 of the draft statement, reference is made to table 2-2 as listing chemical characteristics of ground water; however, the table appears to deal only with surface water. Data on the quality of ground water should be included in the final statement. The impacts of seepage to ground water from the ash ponds, although delayed, should be more adequately discussed in the statement, as many of the constituents do not decrease in toxicity with age and because they differ in sorptive effects, which may be reversible. Furthermore, field conditions and lack of absolute homogeneity in clayey material may result in differences in pollutant travel. We suggest that at least minimal down-gradient monitoring of the most mobile pollutants should be considered as mitigation. It is stated on page IV-29, paragraph 4.02413, that few historical data are available on the presence of toxic or hazardous materials in ash transport waters. However, results of experimental work now in progress are available.

We refer specifically to the work of W.F. Holland, and others, concerning the environmental effects of trace elements in the pond disposal of ash and flue gas desulfurization sludge: Radian Corporation, Austin, Texas, 1975. Although these data point to considerable differences among trace elements in effects of sorption and to dependence upon grain size and distance traveled, the results definitely indicate the need for downgradient monitoring.

Archaeology

The letters of clearance received from the Iowa State Archeologist and the Iowa State Historic Preservation Officer, referenced on page II-61, should be appended to the final statement.

It is noted that specific archeological site information is given on pages A-8, A-9, A-10, and A-37. In the preparation of the final statement, we suggest that consideration be given to the desirability of deleting these pages to minimize the possibility that the sites might be disturbed by amateur archeologists.

Outdoor Recreation

Subsections 4.01202, 4.01203, and 4.01205 make references respectively to previous sections 4.01191, 4.01192, and 4.01194. We were unable to locate these sections in the documents; therefore, the discussions of direct and indirect construction effects and labor force and employment characteristics were somewhat unclear and left only a vague impression of what those effects and characteristics are. The missing sections should be included in the final statement, and the actual impacts of construction activities clarified.

Recreational facilities in the 3-county study area should be more thoroughly examined. Page II-57 notes that the City of Ottumwa has ample recreational space for its population. However, construction workers and their families migrating to the area may choose to locate in surrounding smaller communities where impacts on social facilities may be greater. In clarifying construction impacts in the final statement, we feel recreation should be included and discussed from that standpoint.

We note on page VI-19 that the final selection of transmission line routes has not been made. In doing so, the applicants should be aware of Section 6(f) of the Land and Water Conservation Fund Act of 1965 as amended. Section 6(f) states, "No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness land location." Should the final routes of the transmission lines cross such an area, the final statement should indicate application to the Secretary of the Interior for the required conversion.

Mineral Resources

Known mineral resources of the plantsite and environs include coal, gypsum, limestone, dolomite, clay, and sand and gravel. The draft statement indicates that several strip mines for coal are present on the northeast side of the river within the county and that quarries, clay pits, and sand and gravel pits are present in the area but are outside of the proposed plant site. We believe the draft statement adequately describes the impacts pertaining to minerals, and we do not anticipate any serious conflict between the proposed project and mineral resources.

We hope these comments will be helpful to you.

Sincerely,

Larry E. Meierotto
Deputy Assistant SECRETARY

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

CENTRAL REGION
601 EAST 12TH STREET
KANSAS CITY, MISSOURI 64106

AUG 26 1977

Mr. Charles V. Wright
Acting Regional Administrator
U. S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64106

Subject: Draft Environmental Impact Statement
Ottumwa Generating Station

Dear Mr. Wright:

Review of the subject Draft Environmental Impact Statement does not disclose any conflicts with the plans or programs of this agency.

Thank you for the opportunity to comment.

Sincerely,

Wm Jack Sasser

WM. JACK SASSER
Chief, Airports Division

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION SEVEN

P. O. Box 19715
Kansas City, Missouri 64141

October 7, 1977

IN REPLY REFER TO:
HED-07

Mr. Charles V. Wright
Acting Regional Administrator
U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Dear Mr. Wright:

The Draft Environmental Impact Statement for the Ottumwa Generating Station, Iowa Southern Utilities Company, has been reviewed and we offer the following comments which are associated with secondary impacts:

Section 1.046. Approximately 60 permanent employees will be required to operate the station. This Draft EIS makes no mention of the effect this daily traffic increase will have on the local road system. Some upgrading of the local system may be required.

Section 1.0481. An additional 175 to 250 trains a year will be required to supply coal to the plant. The effect this additional train traffic will have on existing highway-railroad crossings should be addressed. Additional signs or new separations may be necessary.

Sections 6.08 to 6.0833. These Sections concern the transmission lines necessary to distribute the generated power. Before the locations of the lines are determined, coordination with the Iowa Department of Transportation and the affected counties should be established so that conflicts between the transmission lines and existing or proposed highways will be minimized. Poles for the transmission lines should be located at least 30 feet from the edge of any roadway.

Sincerely yours,

for Bernard A. Halver
Steiner M. Silence
Director, Office of Environment & Design

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TELEPHONE 683-1626

Oct. 7, 1977

Ms. Mary Jeanne O'Donnell
Environmental Impact Study Preparation
U. S. Environmental Protection Agency
1735 Baltimore
Kansas City, Mo. 64108

Re: Ottumwa Generating Station,
Iowa Southern Utilities Co.
Environmental Impact Study

Dear Ms. O'Donnell:

I am writing this letter on behalf of 51 property owners and affected property owners whom I represent, in connection with their objections to construction of a 161,000 volt transmission line as proposed by Iowa Southern Utilities Company from the Ottumwa Generating Station for which the Environmental Impact Study is now being prepared.

All of my clients are farm owners, operators or living in rural residential areas that are affected by the transmission line in question. By the testimony of the Iowa Southern Utilities Co., the line as proposed to be constructed is to provide an outlet from the Ottumwa Generating Station for power and therefore the same is relevant to the construction of that station and the Environmental Impact Study being prepared in connection with said construction.

It is my understanding that the Environmental Impact Study states that "where possible, the right of way will be confined to areas devoted to timber and pasture land use. Intensely cultivated land will be avoided. Wherever possible structures will be located in fences or in wasteland." The line as proposed, and as shown on the attached map, would cross some of the best and most intensely cultivated land in Wapello County, Iowa. I sincerely do not believe that Iowa Southern Utilities Co. has taken an objective look at using timber, pasture or wasteland for location of this transmission line, since I am certain that the planning of this line has been in process for some time, and it was only after I met with their officials on Nov. 19, 1976 did they ever give any consideration to using any other route.

I proposed to them at that time that they use the Rock Island Railroad right of way or the Burlington Northern Railroad right of way, lying respectively north and south of the Des Moines River through areas of wasteland, timber and open pasture as a possible alternate route for location of the transmission lines. Instead, they have chosen to follow the path of open country, and using highly cultivated valuable farmland for location of their transmission line, and therefore affect the environment when there are other alternates available which are far less objectional. In addition, this area is now building up into prime rural residential in certain areas in and near the city limits of Ottumwa, particularly between the Ottumwa Municipal Airport and the northern city limits of Ottumwa, and their transmission line will be in and near homes in the $100,000.00 plus category. All of this seems totally and absolutely unnecessary, when there is river bottom wasteland available for location of the transmission line.

Iowa Southern Utilities Co. has offered what they call cost comparisons, for building the various lines after I met with them in November of 1976, but I sincerely believe that a reasonable cost comparison cannot be made, because they are looking in terms of current dollars, and not upon the long range effects of the individual property owners, the valuable farmland, the detrimental affect to rural residential housing, but are only looking at the current price to obtain the property.

Next, I believe that it is very important that generating stations of this kind be not permitted to start construction until the Environmental Impact Studies have been completed. It seems totally unfair to me, to permit these large generating stations to be built, and then once started, they claim hardship if the progress is slowed in any way in connection with the construction. I have done a lot of work for small communities, in connection with the construction of sewage treatment works, and in each instance, we had to hold an Environmental Impact Hearing, long before construction could be commenced. Why are they able to commence construction, and then hold their Environmental Impact Studies at a later time?

Finally, Iowa Southern Utilities Co. has stated that the line as proposed and shown on the attached map, is not pertinent to the construction of the Ottumwa Generating Station. I doubt very seriously the truthfulness of that statement for the reason that first, by the testimony of I.S.U. officials before the Iowa Commerce Commission, they stated that the line as proposed was an outlet for the Ottumwa Generating Station, and secondly, for the reason that even assuming that the line is necessary, they can continue to use the Rock Island Railroad right of way which they use North of the Ottumwa Generating Station for a course South of the Ottumwa Generating Station down to the Wapello

County Substation and they've been using that course for several decades for transmission lines. That course follows wasteland, pastureland and timber and would have the least effect upon the environment, avoid cultivated land and in general affect the least number of people.

The Iowa Southern Utilities Co. objects to using railroad right of way for transmission lines, for the reason that they claim the railroads will object because of inductive interference from their lines into the signaling and communications lines along the railroads. First, the Rock Island Railroad on the north side of the Des Moines River does not have any signaling or communications lines which will be affected. Second, if the Burlington Northern Railroad line on the south side of the Des Moines River were used, I feel that the railroad, who is going to haul the coal into their generating station and sell it to them indirectly, ought to be willing to bear part of the burden of the cost of protecting their lines against inductive interference, and in any case, the Iowa Southern Utilities Co. is going to have to provide protection for inductive interference near their Ottumwa Generating Station whichever course is used.

I strenuously object on behalf of my clients to the location of the transmission line as proposed, and feel that as part of the transmission system generating from the Ottumwa Generating Station that Iowa Southern Utilities Co. should be required to locate their transmission lines in accordance with the statement quoted hereinbefore and locate the same where it is the least detrimental to the environment.

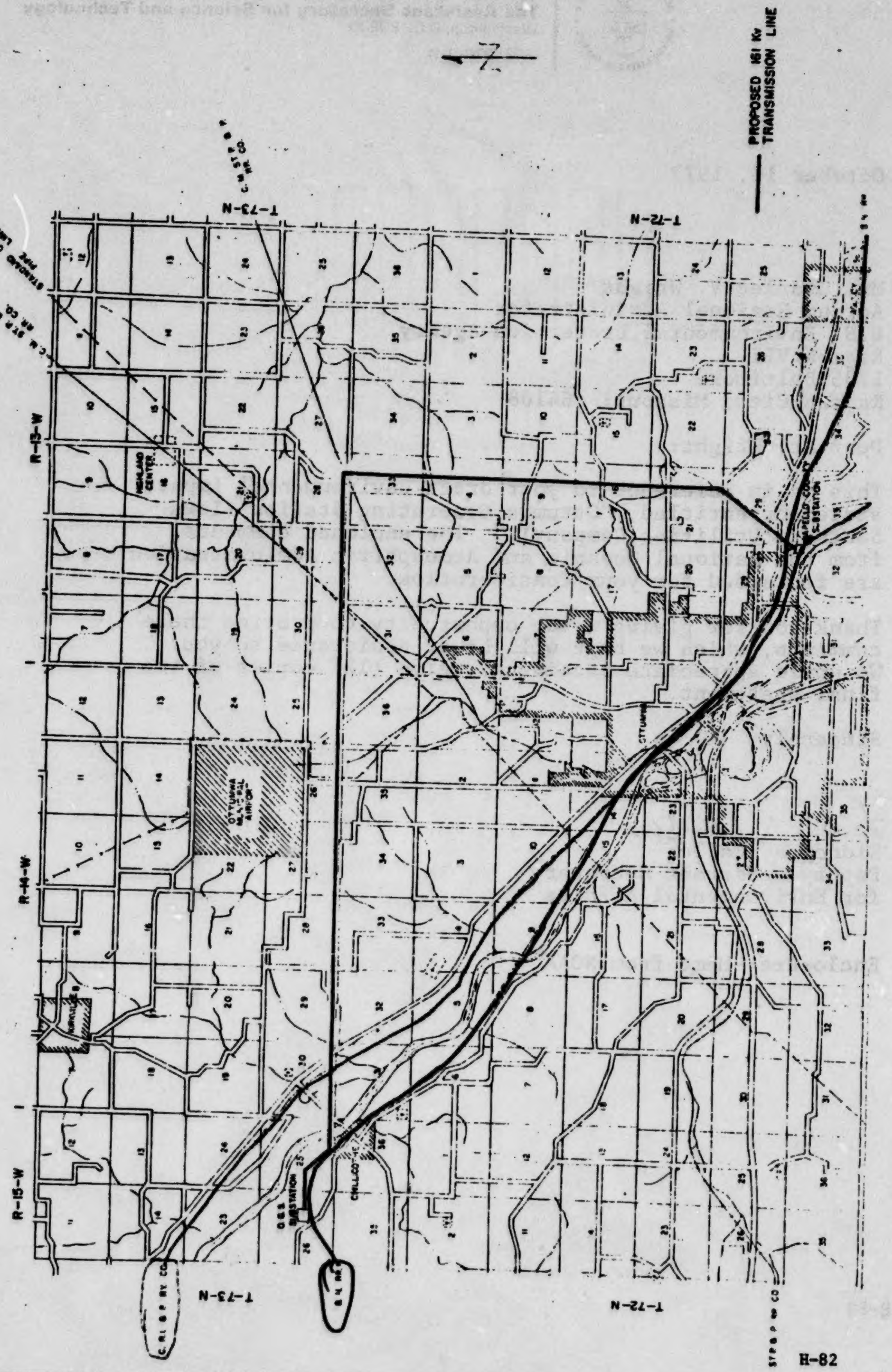
If you wish to discuss this matter further, I would be most happy to review it with you.

Very truly yours,

KIPLE & KIPLE

By Charles M Kiple
Charles M. Kiple

CMK:ev
Enc.


PROPOSED 161 Kv TRANSMISSION LINE
T-73-N
T-72-N
R-13-W
R-14-W
R-15-W
HIGHLAND CENTER
OTTUMWA MUNICIPAL AIRPORT
OTTUMWA
KIRKVILLE
CHILLICOTHE
O.G.& E. SUBSTATION
WAPELLO CO. SUBSTATION
STANDARD OIL PIPE LINE CO
C.M.ST.P & P RR CO
C.RI & P RY CO
B N RR
STP & P RR CO

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Science and Technology
Washington, D.C. 20230
(202) 377-3111

October 18, 1977

Mr. Charles V. Wright
Acting Regional Administrator
U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Dear Mr. Wright:

This is in reference to your draft environmental impact statement entitled, "Ottumwa Generating Station (Iowa Southern Utilities Company)." The enclosed comments from the National Oceanic and Atmospheric Administration are forwarded for your consideration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving twelve (12) copies of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

Enclosure--Memo from NOAA

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE
Silver Spring, Md. 20910

W11x2/MJA

SEP 14 1977

SEP 16 1977

TO: Dr. William Aron
Director, Office of Ecology and Environmental Conservation, EE

FROM: George P. Cressman for Vincent [illegible]
Director, National Weather Service, W

SUBJECT: DEIS 7708.32 - Ottumwa Generating Station

The subject DEIS contains no assessment of the environmental impact of the plant's heat dissipation system, and the heat dissipation system is not described sufficiently to allow an estimate to be made.

The abscissa scale on Figure 2-6 needs correction. The figure cannot be read quantitatively from the two identical scale entries now entered.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

National Wildlife Federation

1412 16TH ST., N.W., WASHINGTON, D.C. 20036

Phone: 202—797-6800

August 22, 1977

Mr. Charles V. Wright
Acting Regional Administrator
U.S. Environmental Protection Agency
Region VII
1735 Baltimore
Kansas City, Missouri 64108

Re: EPA - 7 - IA - Ottumwa Wapello - NSDP - 77

Dear Mr. Wright:

We have received a copy of the Draft Environmental Impact Statement (DEIS) on the proposed issuance of an NPDES permit to the Iowa Southern Utilities Company to discharge wastewater to the Des Moines River (Iowa) from the proposed Ottumwa Generating Station. We offer the following comments.

The DEIS is silent regarding EPA's compliance with the consultation and mitigation requirements of the Fish and Wildlife Coordination Act (FWCA). Section IX of the DEIS describes the consultation procedures followed with other agencies regarding, for example, protection of historic properties, but does not reveal what steps were taken to coordinate with the U.S. Fish and Wildlife Service regarding protection of the fish and wildlife resources of the Des Moines River. Nor does the section on alternatives consider measures to mitigate damage to or loss of these resources. Such measures would include acquisition of replacement habitat for the "approximately 795 acres of agricultural land and wildlife habitat which will be converted to industrial use," selection of the least adverse cooling system, quantification of the expected entrainment/impingement losses, and consideration of artificial aquatic reproduction.

The consultation and mitigation requirements are, of course, fully applicable to the issuance of a new source NPDES permit. *cf*, 40 CFR §125.14 (f) (1973); USFWS *Navigable Waters Handbook*, §1.2, 40 FR 55811 (1975); and *Sun Enterprises Ltd., v. Train*, 532 F2d 280, 288 (2d Cir. 1976).

The Federation recommends that mitigation features such as those referred to above be developed with the assistance of the USFWS, and discussed in the final statement. In the event of a decision to issue the NPDES permit, we recommend the incorporation of suitable mitigation features as special conditions.

Thank you for this opportunity to make our views known. We request that these comments be included in the administrative record.

Sincerely,

Patrick A. Parenteau

Patrick A. Parenteau
Counsel

cc: Harvey Willoughby-USFWS Reg. Dir.
Thomas E. Pritchard-President, Iowa Wildlife Federation
Walter H. Hoff-NWF Reg. Dir.
Charles J. Griffith-NWF Reg. Exec.

RECEIVED
AUG 23 2 25 PM '77
E P A
REGIONAL OFFICE
KANSAS CITY MO.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
REGIONAL OFFICE
ROOM 300, FEDERAL OFFICE BUILDING, 911 WALNUT STREET
KANSAS CITY, MISSOURI 64106

REGION VII

August 16, 1977

IN REPLY REFER TO:

Mr. Charles V. Wright
Acting Regional Administrator
U.S. Environmental Protection Agency
1735 Baltimore
Kansas City, Missouri 64108

Dear Mr. Wright:

We have received the Draft Environmental Impact Statement prepared for your agency for the Ottumwa Generating Station. The document will be forwarded to HUD's Omaha Area Office for review and comment. Mr. Guy Birch, Area Director, will send his comments directly to you.

Thank you for the opportunity to comment on this statement.

Sincerely,

Harry B. Bearman
Environmental Officer
Community Planning and Development

cc:
Guy J. Birch

AREA OFFICES
KANSAS CITY, KANSAS · OMAHA, NEBRASKA · ST. LOUIS, MISSOURI
Insuring Offices
Des Moines, Iowa · Topeka, Kansas

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
AREA OFFICE
UNIVAC BUILDING, 7100 WEST CENTER ROAD
OMAHA, NEBRASKA 68106

REGION VII
Room 300 Federal Office Building
911 Walnut Street
Kansas City, Missouri 64106

August 29, 1977

IN REPLY REFER TO:
7.2SS

Mr. Charles V. Wright
Acting Regional Administrator
U.S. Environmental Protection Agency
1735 Baltimore Street
Kansas City, Missouri 64108

Dear Mr. Wright:

I have received the Draft Environmental Statement for the Ottumwa Generating Station, and have found the document to be satisfactory in meeting the spirit and intent of the National Environmental Policy Act of 1969.

This determination was made on the basis of the following considerations: (1) HUD's areas of review responsibility in accordance with NEPA, and (2) HUD's activities in the Ottumwa, Iowa, area that might be affected by the Environmental Statement.

Sincerely,

Stanley V. Quyle
Environmental Officer

August 29, 1977

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Acting Regional Administrator
U.S. Environmental Protection Agency
1735 Baltimore Street
Kansas City, Missouri 64108

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Sincerely,

Stanley V. Quy
Environmental Officer

STATE OF IOWA

Office for Planning and Programming

523 East 12th Street, Des Moines, Iowa 50319 Telephone 515/281-3711

ROBERT D. RAY
Governor

ROBERT F. TYSON
Director

STATE CLEARINGHOUSE

PROJECT NOTIFICATION AND REVIEW SIGNOFF

Date Received: August 11, 19/7 State Application Identifier: 780445

Review Completed: September 6, 1977

APPLICANT PROJECT TITLE:
Draft Environmental Impact Statement, Ottumwa Generating Station

APPLICANT AGENCY: U.S. Environmental Protection Agency
Address Region VII
Kansas City, Missouri

FEDERAL PROGRAM TITLE, AGENCY AND CATALOG NUMBER: Environmental Protection Agency

AMOUNT OF FUNDS REQUESTED:
NA

PROJECT DESCRIPTION:
Draft Environmental Impact Statement for Ottumwa Generating Station, Iowa Southern Utilities Company as prepared by the U.S. Environmental Protection Agency.

The State Clearinghouse makes the following disposition concerning this application:

/ X / No Comment Necessary. The application must be submitted as received by the Clearinghouse with this form attached as evidence that the required review has been performed.

/ / Comments are Attached. The application must be submitted with this form plus the attached comments as evidence that the required review has been performed.

STATE CLEARINGHOUSE COMMENTS:

CH-14 Rev. 9-75

Federal Funds Coordinator

RESPONSES

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

COMMENT 1: The draft EIS does not adequately address the environmental impact of the bottom and fly ash disposal basins as either interim storage or ultimate disposal methods for these wastes. Soil borings were taken and permeabilities were determied for the proposed disposal sites but the draft does not indicate the thickness of the confining soil layers, the depth of excavation, the basin bottom elevations relative to the groundwater table nor the nature or extent of any groundwater pollution that may result from disposal basin leachate. Further, you should be aware that within the next year DEQ will seek adoption of rules controlling all Coal Combustion Residue disposal activities. Their basis will be existing solid waste disposal statutory authority and will likely require all sites to have adequate cation exchange capacity in the confining soils to handle the waste disposal of the site along with seepage rates low enough to provide sufficient detention for the exchange to take place. It is essential that the final EIS address these matters via a discussion of the groundwater pollution potential of ash basin leachate.

RESPONSE: Bottom ash from a coal-fired power plant is a vitreous agglomeration of metal oxides and silica. As a result, bottom ash generally has low solubility and settles rapidly. These qualities enhance the use of ponds for sedimentation to separate the solid ash and allow reuse of the decanted water.

Fly ash, by contrast, can have solubilities of several per cent. The soluble matter includes iron, nickel and zinc sulfates, and trace quantities of chromium, copper, lead, arsenic and cadmium. However, the major soluble constituents are calcium, magnesium, potassium and sodium sulfates, and anhydrous oxides, none of which are considered pollutants or harmful to man in reasonable concentrations.[1]

Both the fly ash and bottom ash wastes will be disposed by ponding. The potential of environmental degradation by pond leachate, particularly of trace elements is a concern of many on-going investigations with little historical data compiled to date.

Leaching studies on ash ponds by Radian Corporation[2] included the determination of solubility of the trace elements and the capacity of soils for the removal of trace elements from pond leachate. The studies conclude that the major species leach (Ca, Na, K, Mg, Fe, OH, CO_3, Cl, SO_4, and NO_3) in the soluble state, but that the trace elements (Ar, Cd, Cu, Pb, Mn, and ZN) remained well within EPA primary standards for drinking water. Some leaching of Ba, B, Cr, Hg, and Se did occur in at least one trial as potential pollutants and further concern should be with these elements.

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[1] Rice, J. K. and S. D. Strauss, "Water-Pollution Control in Steam Plants," Power, Vol. 120, No. 4, April 1977, pp. S1-S20.

[2] Radian Corp., Final Report, The Effects of Trace Elements in the Pond Disposal of Ash and Flue Gas Desulfurization Sludge, Sept. 8, 1975.

Absorption studies of trace elements contained in fly ash have been conducted by Notre Dame University. The results indicate that trace metals are associated with surface coatings of amorphous iron and aluminum oxides and MnO_2. At neutral pH ranges cadmium was most readily desorbed from the fly ash surfaces followed by lead, chromium, copper and zinc. Mercury behaved anomalously due to its presence of the elemental (vapor) form.[3]

Ion exchange between soil and power plant waste pond leachate was evaluated by Twin City Testing; St. Paul, Minnesota.[4] The process can involve either anion or cation exchange between leachate and soil. The test results concluded that different cations have different powers of replacement with the predominant exchanged cations being hydrogen, calcium, magnesium, potassium, sodium and ammonium.. Zinc, manganese and copper also exchange but in smaller amounts.

In the exchange process, the cations of the clay minerals are replaced by the cations of the leachate. Sodium accounted for most of the ions liberated from the clay and exchanged to the leachate. Potassium and manganese were the other ions also liberated from the clay minerals.

Calcium and magnesium (the hardness ions) were primarily used to replace the sodium in the clay, thereby reducing the hardness of the leachate.

Coprecipitation was also determined to be an important removal mechanism of ions from the leachate. This phenomena resulted in drastic reductions of calcium, magnesium and boron in the leachate.

Studies by Griffin also support the theory of ion-exchange and conclude that a wide range of pollutant attenuation can be achieved by various clays.[5]

Borings of the ash pond area by Atec Associations; Indianapolis, Indiana, indicate at least 5.0 ft of clay or silty clay exists as the subgrade overlying sandy silt and/or bedrock. Permeability tests by Patziz Testing

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[3] Theis, T. L. et al, "Sorbtive Characteristics of Heavy Metals in Fly Ash-Soil Environments," Presented at the 31st Purdue Industrial Waste Conf., West Lafayette, Indiana, May 1976.

[4] "Evaluation of Scrubber Sludge; Northern States Power Co., Sherco Scrubber Sludge, Unpublished report, Sept. 6, 1977.

[5] Griffin, R. A. et al, "Attenuation of Pollutants in Municipal Landfill Leachate by Passage Through Clay," Environmental Science & Technology Vol. 10, No. 13, Dec. 1976, pp. 1262-1268.

Laboratories Co., Inc.; Des Moines, Iowa, also on borings from within the ash pond area indicate a maximum permeability of 1.06×10^{-7} cm/sec. The lowest point within the ash pond will be approximately 4.6 feet above the nearest aquifer. It was calculated that at the highest permeability rate measured by Patziz Laboratories (3 cm/yr), it would take 47.7 years for any water from the ash pond to reach the nearest aquifer. The infiltration rate of 1.06×10^{-7} cm/sec yields a groundwater recharge from the ash ponds of 0.07 gpm/acre. From this rate, the total recharge rate of the ash ponds will be:

(1) Fly ash pond (34 acres): 2.3 gpm.

(2) Bottom ash pond (40.5 acres): 2.75 gpm.

(3) Runoff pond (2.2 acres): 0.15 gpm.

Clay lining generally has an impermeability in the range of 1.0×10^{-6} cm/sec implying that the existing subgrade is as equal or better lining material than the commercially available products. Synthetic lining (such as rubber or vinyl) provide only a temporary leachate barrier with a finite life expectancy of 10-50 years.

It can be concluded that the combined effects of absorption, ion exchange, coprecipitation and impermeability will remove much of the trace metals including arsenic, boron, cadmium and lead, and other chemical substances contained in the ash pond leachate.

COMMENT 2: First, plans for the design and construction of ash basins need to be submitted to DEQ's Air and Land Quality Division so that the proposed design can be reviewed for consistency with currently accepted engineering practice and proposed coal combustion residue rules.

RESPONSE: Plans for design and construction of ash basins have been submitted to the Water Quality Division, IDEQ, and a construction permit has been issued.

COMMENT 3: Second, a groundwater monitoring plan must be designed and implemented to monitor for constituents consistent with ash content both up and down groundwater gradient of all disposal basins. It should include adequate numbers of wells and a sampling and analysis program for their use prior to and after OGS begins operating. This program should be submitted for DEQ's review and approval as soon as possible.

RESPONSE: EPA is coordinating with the Iowa Department of Environmental Quality concerning the groundwater monitoring.

COMMENT 4: The flow, potential high iron, acidity or other quality of runoff or runoff/leachate combination from the coal storage area is not specified in the EIS. Obviously, water quality standards have to be met for this intermittent discharge but monitoring a discharge for unknown and potential toxic constituents or acidity during the actual discharge, regardless of what the Water Quality operation permit specifies as monitoring requirements, may be too late to ensure that acid or toxic discharges do not take place. Given the lack of information about the pollution potential acidity or toxicity of such a discharge a more environmentally sound solution might be to route this discharge to the bottom ash basin for treatment or provide for some type of neutralization when necessary. Even though NSPS considers such storage and discharge to be adequate treatment, this does not mean impact of such a potentially acidic discharge should not be discussed. The final EIS needs to discuss the probable acid, iron or other potentially toxic content of the coal runoff and leachate storage basin discharge and what mitigating measures are available.

RESPONSE: Please refer to responses to Iowa State University comment numbers 30, 31, and 33.

COMMENT 5: The exact location of the discharges to the river is not contained in the draft EIS. These must be specified. Under no circumstances are discharges to Avery Creek allowable.

RESPONSE: There will be no discharges into Avery Creek. The location of the discharge from the bottom ash pond is approximately 401.275 N and 2,263.040 E. The location of the discharge from the coal pile runoff pond is approximately 403.600 N and 2,261.160 E.

COMMENT 6: The nature or extent of any chemical or thermal block or other physical impact on river flow that may be created by the bottom ash basin discharge is not discussed, nor is the lack of or need for such mitigating measures as a diffuser on the discharge pipe. Both items need to be addressed in the final EIS.

RESPONSE: Please refer to responses to Iowa State University comment numbers 30, 31, 33, and 59.

The use of a diffuser is not indicated.

COMMENT 7: Hastily constructed and abandoned temporary crossings of Avery Creek for the purpose of access to the construction site have caused considerable siltation of that important game fish nursery stream of the Des Moines River. DEQ's information as of September 1977, indicates the resulting exposed fills and cuts are still eroding and stream siltation is continuing. If this stream is to adequately recover from this siltation, repair and revegetation of slopes exposed during construction is essential and must be done at the earliest possible time. If erosion damage is extensive provisions should include riprap to prevent further siltation. Any such mitigating activities ISU is planning in order to correct these problems need to be discussed in the final EIS.

RESPONSE: Please refer to response to Iowa State University comment number 8.

COMMENT 8: The air quality impact of non-criteria pollutants not covered by NSPS such as sulfates, fluorides and trace elements emitted by OGS, is not addressed adequately in the final EIS. The final EIS must specify how emission rates and ground level concentrations contained in Tables 4-7 thru 4-10 were estimated. Of particular concern is the lack of documentation about expected fluoride, arsenic and mercury ground level concentrations, the complete lack of any mention of sulfates, and the apparent assumption that the only form of fluoride emitted is particulate.

RESPONSE: The ground level concentrations of the gaseous emissions of trace elements shown in Table 4-7 were calculated as a ratio of the SO_2 emission rate and ground level concentration. The ground level SO_2 concentrations were multiplied by the ratio of the trace element emission rate (#/hr) to the SO_2 emission rate (#/He), times the ratio of the molecular weight of SO_2 (#/mole) to give the ground level concentration of the trace elements.

The values shown for the ground level concentrations of fly ash are incorrect. The correct values are as follows.

(1) 3-hour Average--1.62 $\mu g/m^3$.

(2) 24-hour Average--0.55 $\mu g/m^3$.

(3) Annual Average--0.033 $\mu g/m^3$.

The concentrations of trace elements in the fly ash shown in Table 4-8 were calculated by dividing the concentration of the trace element in the coal by the percentage of ash in the coal.

The maximum ground level concentrations of the various trace elements in Table 4-9 were determined by multiplying the maximum ground level concentrations of fly ash from Table 4-7 times the concentration of the trace elements in the ash (Table 4-8). Since the concentrations of fly ash in Table 4-7 are incorrect, a revised Table 4-9 is attached.

The data contained in Table 4-10 was calculated from the trace element feed rates shown in Table 1-7. The trace element feed rate was multiplied by 0.9952 (1.0-0.0048) times the number of hours in 30 years at a 55.8 per cent load factor to give the quantity of trace elements deposited in the ash pond. The trace element emission rate was also multiplied by the number of hours in 30 years at a 55.8 per cent load factor to give the quantity emitted from the chimney.

COMMENT 9: ISU needs to perform a fluoride mass balance study for the proposed OGS unit and include it as part of the EIS so that all fluoride emissions and resultant ground level concentrations can be estimated as closely as possible. This study should include an assessment of the variability of the fluoride content in the coal ISU has chosen to burn. The

TABLE 4-7. TRACE ELEMENT EMISSIONS—OTTUMWA GENERATING STATION MAXIMUM EXPECTED GROUND LEVEL CONCENTRATIONS

		Gaseous Emissions			
	Stable Form in Flue Gas	3-Hour Average ppb(mg/m^3)	24-Hour Average ppb(mg/m^3)	Annual Average ppb(mg/m^3)	Limits for Human Exposure[a] mg/m^3
Arsenic	As_2O_3	0.014(0.115)	0.0048 (0.0039)	0.0003 (0.0025)	0.5
Boron	B_2O_3	0.9(2.6)	0.3(0.87)	0.018(0.52)	15.0
Bromine	$CaBr_2$	0.009 (0.075)	0.003 (0.025)	0.002 (0.017)	0.7
Chlorine	$CaCl_2$	0.5(2.3)	0.116(0.77)	0.01(0.05)	
Fluorine	CaF_2	0.018(0.03)	0.006(0.01)	0.00036 (0.0006)	2.5
Iodine	I_2	0.00042 (0.0044)	0.00014 (0.0015)	0.000008 (0.000084)	10.5
Mercury	HgO	0.00017 (0.0015)	0.000058 (0.0005)	0.0000034 (0.00003)	0.1
Rubidium	Rb_2O_3	0.0036 (0.033)	0.0012 (0.011)	0.000072 (0.00066)	
Selinium	SeO_2	0.0024 (0.011)	0.00073 (0.0034)	0.000043 (0.0002)	0.2

	Particulate Emissions		
Component	3-Hour Average μg/m^3	24-Hour Average μg/m^3	Annual Average μg/m^3
Fly Ash	1.62	0.55	0.033

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[a] Title 29, Code of Federal Regulations, Part 1910.1000. Established by OSHA for an 8-hour shift.

TABLE 4-8. FLY ASH TRACE ELEMENT ANALYSIS OTTUMWA GENERATING STATION

Element	Stable Form in Fly Ash	Concentration in Fly Ash ppm
Barium	$BaO-BaSO_4$	1503-5598
Beryllium	BeO	4.8-38.5
Cadmium	CdO	7.9-19.8
Cerium	$CeO_2-Ce_2O_3$	244-974
Chromium	Cr_2O_3	355-2432
Cobalt	CoO	66-154
Copper	CuO	347-781
Gallium	Ga_2O_3	233-606
Iron	Fe_2O_3	135,786
Lanthanum	La_2O_3	163-406
Lead	PbO	18.7-74.6
Lithum	LiOH	12.9-172
Manganese	MnO_2	164-905
Molybdenum	MoO_3	78-338
Neodymium	Nd_2O_3	23.5-93.9
Nickel	NiO	110.3-308
Niobium	Nb	17.3-86.6
Praseodymium	Pr_2O_3	8.1-40.6
Samarium	Sm_2O_3	16-40.2
Strontium	SrO	2664-5636
Thorium	ThO_2	39.4-59.2
Tin	SnO	7.9-15.7
Titanium	TiO_2	10,262-18,212
Uranium	UO_2	39-59
Vanadium	V_2O_3	714-2754
Yttrium	Y_2O_3	220-1,012
Zinc	ZnO	108-496
Zirconium		190.6-918

TABLE 4-9

MAXIMUM EMISSION CONCENTRATIONS OF TRACE ELEMENTS IN FLY ASH EXPECTED FROM OTTUMWA GENERATING STATION COMPARED TO LIMITS FOR HUMAN EXPOSURE, MICROGRAMS PER CUBIC METER

Element	3-Hour Average	24-Hour Average	Annual Average	Limits of[a] Human Exposure
Barium	0.004	0.0013	0.000080	0.5
Beryllium	0.00002	0.00006	0.000003	0.002[b]
Boron	0.0014	0.0005	0.00003	15.0
Cadmium	0.0003	0.00001	0.000007	0.2[b]
Chromium	0.0003	0.0001	0.0000005	0.5
Copper	0.0003	0.0001	0.000007	1.0
Cyanide	0.000002	0.000006	0.00000004	5.0
Fluoride	0.0066	0.0022	0.000130	2.5
Gallium	0.00002	0.00006	0.0000003	--
Iron	0.06	0.019	0.0011	10.0
Lead	0.0006	0.00002	0.0000011	0.2[b]
Nickel	0.0001	0.00004	0.0000023	1.0
Thorium	0.009	0.0030	0.00018	--
Uranium	0.0006	0.00002	0.0000011	0.2
Vanadium	0.001	0.00045	0.000030	0.5
Zinc	0.0006	0.00020	0.000012	5.0

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[a] US Federal Registry, Vol. 36, No. 105.

[b] 8-hour time weighted average.

TABLE 4-9. MAXIMUM EMISSION CONCENTRATIONS OF TRACE ELEMENTS IN FLY ASH EXPECTED FROM OTTUMWA GENERATING STEAM COMPARED TO LIMITS FOR HUMAN EXPOSURE, MICROGRAMS PER CUBIC METER

Element	3-Hour Average	24-Hour Average	Annual Average	Limits of[a] Human Exposure
Barium	0.009	0.003	0.0002	0.5
Berylium	0.00006	0.00002	0.000001	0.002[b]
Cadmium	0.00003	0.00001	0.0000007	0.2[b]
Cerium	0.0015	0.00054	0.00032	0.2[b]
Chromium	0.002	0.0007	0.00004	0.5
Cobalt	0.00025	0.000085	0.000005	0.5
Copper	0.0013	0.0004	0.000025	1.0
Gallium	0.0005	0.0002	0.00001	
Iron	0.1	0.04	0.002	10.0
Lanthanum	0.00064	0.00022	0.000013	
Lead	0.0001	0.00004	0.000002	0.2[b]
Lithium	0.00028	0.000096	0.000006	
Manganese	0.0015	0.00051	0.00003	
Molybdenum	0.00055	0.00019	0.00011	
Neodymium	0.00013	0.000044	0.0000026	15.0
Nickel	0.0005	0.0002	0.00001	1.0
Niobium	0.00014	0.00005	0.000003	
Praseodymium	0.000063	0.00002	0.0000013	
Samarium	0.00006	0.00002	0.0000013	
Strontium	0.009	0.003	0.00018	
Thorium	0.0001	0.00003	0.000002	
Tin	0.00003	0.00001	0.0000006	
Titanium	0.52	0.18	0.01	
Uranium	0.0001	0.00003	0.000002	0.2
Vanadum	0.0044	0.0015	0.00009	0.5
Yttrium	0.0017	0.00059	0.000035	1.0
Zinc	0.0008	0.0003	0.00001	5.0
Zirconium	0.0015	0.0005	0.00003	5.0

[a] Title 29, Code of Federal Regulations, Part 1910.1000. Established by OSHA for an 8-hour shift.

[b] 8-hour time weighted average.

TABLE 4-10

ESTIMATED AMOUNTS OF TRACE ELEMENTS ASSOCIATED WITH THE OPERATION OF OGS FOR 30 YEARS

(55.8 Percent Average Load Factor)

Element	Total Amount Disposed in Ash Pond tons	Total Amount Emitted From Stack tons
Arsenic	0	73-292
Barium	3721-13,864	18-67
Beryllium	7.3-58.4	0.035-0.28
Boron	14.4-59	645-265.3
Bromine	1.5-21.9	13.2-198
Cadmium	29-73	0.14-0.35
Cerium	438-1751	2.1-8.4
Chlorine	160-1356	1452-12,237
Chromium	511-3502	2.5-16.9
Cobalt	219-511	1.0-2.5
Copper	1168-2627	5.6-12.7
Fluorine	2,333-18,739	726-583
Gallium	365-950	1.75-4.6
Iodine	0	7.3-14.6
Iron	199,935	964
Lanathanun	292-730	1.4-3.5
Lead	73-292	0.35-1.4
Lithium	29.2-219	0.14-1.05
Manganese	438-2408	2.1-11.6
Mercury	2-4.2	0.19-9.75
Molybdenum	219-949	1.05-4.6
Neodium	36.5-146	0.17-0.7
Nickel	365-1022	1.7-4.9
Niobium	73-365	0.35-1.7
Praseodymium	14.6-73	0.07-0.35
Rubidium	68.5-1302	4.4-83.6
Samarium	29.2-73	0.14-0.35
Selenium	1.2-4.2	13.5-47.1
Strontium	9486-20,066	45.7-96.8
Thorium	146-219	0.7-1.05
Tin	29-58.4	0.14-0.28
Titanium	25,880-45,927	125-222
Uranium	146-219	0.7-1.05
Vanadium	1021-3937	4.9-19
Yttrium	365-1677	1.75-8.1
Zinc	365-1677	1.75-8.1
Zirconium	802-3864	3.87-18.6

TABLE 1-7. ANALYSIS OF TRACE ELEMENTS OF CORDERO COAL AND EXPECTED EMISSIONS FROM OTTUMWA GENERATING STATION

Element	Concentration in Coal ppm	Feed Rate* lb/hr	Per Cent Emitted %	Emission Rate ppm in Flue Gas*	Emission Rate* gm/sec	Emission Rate* lb/hr
Arsenic	1-4	0.86-3.4	100	0.04-0.16	0.11-0.43	0.86-3.4
Barium	51-190	43.9-163	0.48		0.03.0.1	0.21-0.78
Beryllium	0.1-0.8	0.085-0.69	0.48		0.0000054-0.0003	0.00004-0.003
Boron	9-37	7.7-31.8	97.8	2.45-10	0.95-3.9	7.5-31.15
Bromine	0.2-3.0	0.17-2.6	90	0.0066-0.1	0.019-0.295	0.15-2.34
Cadmium	0.4-1.0	0.35-0.86	0.48		0.0002-0.0006	0.0017 0.0048
Cerium	6-24	5.2-21.0	0.48		0.003-0.0126	0.025-0.1
Chlorine	22-186	18.9-160	90	0.23-5.63	0.295-7.1	2.34-56.5
Chromium	7-48	6.0-41.3	0.48		0.004-0.025	0.029-0.2
Cobalt	3-7	2.6-6.0	0.48		0.0015-0.0037	0.012-0.029
Copper	16-36	13.8-31.0	0.48		0.008-0.019	0.066-0.15
Fluorine	33-265	28.4-228	3	0.026-0.2	0.017-0.14	0.136-1.09
Gallium	5-13	0.86-11.2	0.48		0.025-0.007	0.02-0.054
Iodine	0.1-0.2	0.086-0.17	100	0.0024-0.0047	0.01-0.021	0.086-0.17
Iron	2740	2356	0.48		1.42	11.3
Lanthanum	4-10	3.4-8.6	0.48		0.002-0.005	0.016-0.04
Lead	1-4	0.86-3.4	0.48		0.0005-0.002	0.004-0.016
Lithium	0.4-3.0	0.34-2.6	0.48		0.0002-0.0015	0.0016-0.012
Manganese	6-33	5.2-28.4	0.48		0.003-0.018	0.025-0.14
Mercury	0.03-0.19	0.25-0.16	9-70	0.000039-0.0019	0.0003-0.014	0.00225-0.11
Molybdenum	3-13	2.6-11.2	0.48		0.0015-0.0068	0.012-0.054
Neodymium	0.5-2.0	0.43-1.7	0.48		0.00025-0.001	0.002-0.0082

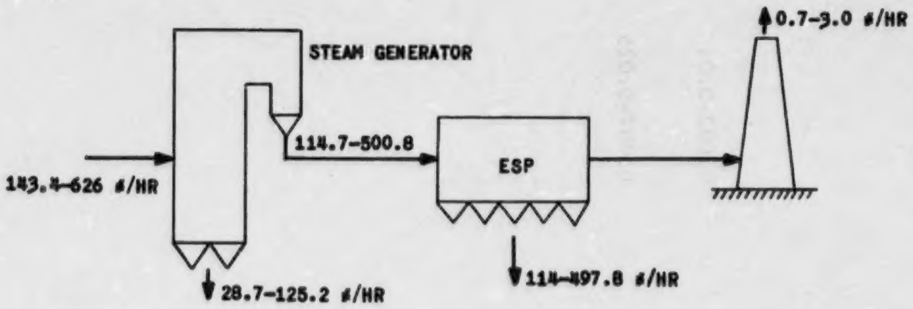
TABLE 1-7. ANALYSIS OF TRACE ELEMENTS OF CORDERO COAL AND EXPECTED EMISSIONS FROM OTTUMWA GENERATING STATION (Continued)

Element	Concentration in Coal ppm	Feed Rate* lb/hr	Per Cent Emitted %	Emission Rate ppm in Flue Gas*	Emission Rate* gm/sec	Emission Rate* lb/hr
Nickel	5-14	4.3-12.0	0.48		0.0025-0.0073	0.02-0.058
Niobium	1-5	0.86-4.3	0.48		0.0005-0.0026	0.004-0.021
Praseodymium	0.2-1.0	0.17-0.86	0.48		0.0001-0.0005	0.0008-0.004
Rubidium	1-19	0.86-16.3	6	0.002-0.04	0.0063-0.12	0.05-0.98
Samarium	0.4-1.0	0.35-0.86	0.48		0.0002-0.0005	0.0017-0.004
Selinium	0.2-0.7	0.17-0.6	91.8	0.007-0.025	0.02-0.0076	0.16-0.55
Strontiom	130-275	112-236	0.48		0.068-0.14	0.54-1.13
Thorium	2-3	1.7-26	0.48		0.0001-0.0015	0.008-0.0012
Tin	0.4-0.8	0.35-0.69	0.48		0.0002-0.00042	0.0017-0.0033
Titanium	355-630	305-542	0.48		0.174-5.8	1.38-46.6
Uranium	2-3	1.7-2.6	0.48		0.0001-0.0015	0.008-0.012
Vanadium	14-54	12-46.4	0.48		0.0075-0.03	0.06-0.22
Yittrium	5-23	4.3-19.8	0.48		0.0025-0.0126	0.02-0.1
Zinc	5-23	4.3-19.8	0.48		0.0025 0.012	0.02-0.095
Zirconium	11-53	9.45-45.6	0.48		0.0057-0.028	0.045-0.22

*Based on a coal feed rate of 859,806 #/hr resulting range of emission rates and ground level concentrations needs to be discussed in the EIS in terms of current knowledge of the environmental impact of fluorides.

RESPONSE: The following mass balance is based on a fluoride feed rate of between 69.6 and 304 pounds per hour. This corresponds to a fluoride concentration in the coal of 80-350 parts per million. This is equal to a fluoride feed rate (expressed as CaF_2) of 143.4 to 626 pounds per hour.

Twenty per cent of the fluoride will be removed with the bottom ash. Of the remaining 80 per cent, 99.4 per cent is removed in the electrostatic precipitator. The remainder is emitted to the atmosphere.



The maximum fluoride emission rate is therefore 3 #/hr. Based on a fly ash emission rate of 238 #/hr, the maximum ground level concentrations of fluoride is equal to 3/238 times the maximum fly ash concentration. The maximum ground level concentrations of fluoride are as follows.

(1) 3-hour Average--0.02 $\mu g/m^3$.

(2) 24-hour Average--0.007 $\mu g/m^3$.

(3) Annual Average--0.0004 $\mu g/m^3$.

COMMENT 10: Secondly, DEQ is aware that even though NEPA requires complete assessment of environmental impact prior to plant operation, current knowledge of emission rates and prediction methods for ground level concentrations for these non-criteria pollutants has not been sufficiently verified such that their impact is known within required confidence limits. Also, sufficient research has not been performed so that adequate ambient air quality standards can be set for these pollutants. These reasons plus the fact that OGS will be burning over 2 million tons of coal a year in a location currently without pollution sources of this size leads DEQ to conclude that biological up-take and air quality monitoring for these additional air pollution parameters is necessary. It is essential that such monitoring be performed both before and after OGS begins operations in order to assure that an accurate assessment can be made of the true environmental impact of OGS's air pollutants after the plant has begun operation. Specifically, the EIS needs to address non-criteria pollutants by outlining how ISU will implement the following monitoring program at least 2 years prior to plant operation and continue after the plant begins operations until ISU and DEQ mutually agree it is no longer useful.

(1) Dry fallout and precipitation event monitoring and analysis for fluorides, sulfates and rain pH,

(2) Some mobile monitoring of subacute levels of SO_2 and ozone combinations may occur,

(3) Analysis of high-volume air sampling filters for sulfate and fluorides, and

(4) Quarterly biological monitoring.

This biological monitoring program typically would consist of sites at five select downwind distances in each four directions (20 total) for (a) taking quarterly samples of conifers and agricultural plants to be analyzed for fluoride and sulfate scavanging, uptake and damage, placing corrobornating fluoride and sulfation plates for analysis, and analysis of fluoride content of the bones of known concentrators of fluorides (such as field mice).

RESPONSE: In regard to the comprehensive air quality monitoring program, as set forth by the Iowa Department of Environmental Quality in these comments, EPA is attempting to establish such an effort as a research and development project and is coordinating with IDEQ, Iowa Southern Utilities, and relevant EPA offices toward this end.

COMMENT 11: Several areas of potential environmental impact are not well defineable at this time. These are trace element fluoride and sulfate impact on air quality and, if they occur, ash basin leachate and coal pile runoff impact on water quality. Because of this DEQ has chosen to require that ISU include as part of the final EIS exactly how these impacts will be determined or mitigated at a later date. In order to ensure that this takes place, DEQ should be consulted concerning the specific content of the final EIS prior to issuance so that we might have input into the design of any environmental impact monitoring programs that might be proposed as fulfillment of ISU's and EPA's responsibilities under NEPA.

RESPONSE: Refer to response to United States Department of the Interior comment number 10.

RESPONSES

IOWA STATE UNIVERSITY

COMMENT 1: In order to evaluate the impacts on the flood plain by the OGS, a more definitive assessment of this intrusion is needed. The surface areal extent of the facility is specified as 795 acres. In addition, an effluent stack will extend 600 feet into the overlying airspace. No mention is made of the plant's subsurface extent, but it would be a logical assumption that a minimum of 30 to 50 feet of underlying soil will be penetrated by foundations, pilings, etc.

In addition to the physical confines of the site, additional land will be utilized by various arterial connectors including access roads, rail right-of-ways and transmission line corridors.

These spatial requirements have been poorly quantified in the Draft EIS, and insufficient justification is offered for them. Section 6.072 dictates 600 acres as the surface space requirement for the designed facility, and includes this as a site selection factor. However, the 30 per cent surplus afforded by 795 acres is unexplained.

RESPONSE: The heavy structures on this site will be supported by concrete piers which extend 30 to 40 feet to bedrock. The lighter structures will be supported by spread footings which extend approximately five feet below grade.

A sizable portion of the 795 acre site cannot be utilized for construction (except for the intake structure and outfalls) because of restrictions by the Iowa Natural Resources Council. Based on studies made by the U.S. Corps of Engineers, construction will not be permitted within a line 1,012 feet from the centerline of the Des Moines River adjacent to the site. To obtain the minimum 600 acres needed for the plant facilities, it was necessary to acquire 795 acres which included the flood plain area. It was not practical to purchase exactly 600 acres. In some cases it was necessary to purchase entire forms. Any land not utilized for the plant site will continue to be used for agricultural purposes.

COMMENT 2: Throughout the draft statement, implications are made to the effect that the generating unit now proposed for the OGS is only a "first unit," leaving inference that it will be joined by another at a later date. This could expalin the additional acreage acquired, but such an addition raises a host of other questions, among them . . . would a supplemental EIS be researched and prepared for such an addition? If it is in the overall plans, why wasn't the addition considered in the present EIS? Will increased generating capacity at the site proportionately increase adverse environmental impacts, and if so could these be tolerated? Here the issue of "segmentation" previously raised in NEPA litigation needs to be resolved. Unfortunately, the draft statement at present sidesteps this very critical issue.

RESPONSE: The present environmental statement is concerned with one 727 megawatt generating unit. The construction of any additional units would require federal, state, and local permits and necessitate an environmental analysis by the applicant. An Environmental Impact Statement would be prepared by the appropriate regulatory agency.

COMMENT 3: Flood plain land use impact of the other transportation corridors (excluding transmission lines) is but vaguely treated in the Draft EIS. For example, the unit coal trains are explained, but such considerations as right-of-way location in the valley and construction of these rights-of-way are ignored.

RESPONSE: The Burlington-Northern railroad runs adjacent to the plant site. A spur line approximately one-quarter mile long will be constructed to the site adjacent to the existing main line. The construction of this short length of rail line will have little effect. The near location of transportation facilities was one major consideration in selecting the site.

The design of all railroad embankments was studied by the Iowa Natural Resources Council and a determination was made that the effects would be acceptable according to their criteria before a construction permit was issued.

COMMENT 4: The primary consideration in site selection for the OGS and the reason a flood plain intrusion was even required was for the ready availability of water for consumptive use. This requirement was met at the Chillicothe location by the Des Moines River.

The consumptive demand from the Des Moines River is presented in Section 1.0441 as 17 cubic feet per second maximum and 12 cfs average. This is consistent with the river water withdrawal permit applied for with the Iowa Natural Resources and profiles in the past decade, a very crucial consideration is ignored . . . how will consumptive demand be met during sustained dry periods when the flow of the Des Moines River at the site is at or below minimum protected flow levels as specified by the Iowa NRC? At the present time the guaranteed flow to the city of Ottumwa is 300 cfs (as effluent from Red Rock Reservoir). If and when this flow cannot be maintained by natural occurrence or reservoir regulation, all withdrawal rights along affected stretches as granted by an Iowa NRC permit as immediately suspended until such time as adequate flow resumes.* A two-week notice is given to all permit holders when critical flow levels are impending. Thus, a possibility exists that withdrawals from the Des Moines River in the region of the OGS site will be temporarily terminated.

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*Iowa Government Publication 580--Natural Resources Council Bylaws.

How would the OGS meet such a crisis were it presently in operation? Response to this possibility is absent in the draft EIS. Obviously, the consumptive water demand of the generating facility would have to be satisfied if operation were to continue. One must merely speculate on the alternatives since they are unmentioned. Making a quick calculation based on the stated average consumptive requirement of 12 cfs, one finds for every day of operation this represents approximately 24 acre-feet of water, or 8 million gallons. This is a sizable quantity of water to obtain from any source. It would ridiculously overtax the remote Ottumwa municipal supply. It would represent a very sizable well field to exploit for only standby use. The most viable alternative would appear to be construction of a nearby standby reservoir that could be filled via river pumping during adequate river stages or left to fill from natural precipitation. Such a reservoir would have to be sizable (assuming only a two-week standby capacity and an average water depth of 8 feet, 42 acres would be required), but nonetheless potentially possible due to the rolling nature of the surrounding terrain. Of course, such an undertaking would require a comprehensive impact analysis of its own.

RESPONSE: In the event that the flow of the Des Moines River falls below 300 cfs, there are several alternatives available. These alternatives are being evaluated and a definite conclusion will be reacted in the near future. Alternatives that are being considered are as follows.

(1) When low-flow conditions occur (less than 300 cfs), the operation of OGS will be stopped. Considering the probability of these flow conditions occurring, this might be the best alternative.

(2) It may be possible to purchase additional water storage in either Red Rock or Saylorville Reservoirs. Discussions are currently in progress with the U.S. Corps of Engineers.

(3) Water may be available from an impoundment other than Red Rock or Saylorville Reservoirs. This alternative is actively being pursued.

(4) Another alternative would be to construct a storage impoundment near the OGS site.

COMMENT 5: Another serious oversight of the Draft EIS related to consumptive water use involves the proposed water intake structure along the west bank of the river channel. The location for this permanent structure was chosen because of the location of the main channel (and thus maximum water depth) along this shore. However, the exact channel location of the Des Moines River like most meandering Iowa rivers is subject to change with time, flooding, etc. Furthermore, the very presence of the intake structure in the water could cause severe enough velocity drop at its downstream face that sedimentation would be drastically accelerated in that vicinity; this would procide increased hydraulic incentive for shifting of the main channel location. An issue of serious environmental impact is then raised: if

water depth became insufficient at the intake structure, what would be the recourse . . . channel dredging, intake relocation, or what? Treatment of this entire subject is missing in the EIS.

RESPONSE: The channel of the Des Moines River is not expected to shift significantly in the next 30 years (estimated life of the generating station). Should the water depth become "insufficient," it probably would be necessary to relocate the intake structure. Based on hydraulic studies of the river near the OGS, such an action is unlikely.

The intake structure was located on the basis of hydraulic studies of the river including sedimentation problems. Should the water depth become "insufficient," appropriate permits will be obtained to correct the situation. Studies indicate that such a condition is unlikely.

COMMENT 6: While consumptive use of Des Moines River water will be made, an unknown amount of effluent water will be returned to stream. As stated in Section 4.02410, discharge will be made into the river upstream of Avery Creek. This discharge will be made only during times of "high precipitation." This statement of the effluent water discharge raises more questions than it answers.

By not specifying the exact amounts and schedule of such discharges, it is impossible to project impacts with any certainty. Discharge is also said to come from the ash basins, but with no reference or analysis to the mechanism involved . . . controlled pumping, weir overflow, or what? The impacts of this discharge stream both in terms of the pollutants it carries and the river flow alteration it causes (channel degradation, for example) are closely related to the dispersal method. The intent to discharge during high precipitation periods implying high river stage is a good one since it would afford maximum dilution and thus minimum impact of pollutants. No mention is made of the intent or effects of discharge during periods of low flows. It is not explained if discharges would occur regardless, or if detention facilities are adequate to wait out such periods.

RESPONSE: The plant water mass balances with flow tabulations under maximum and average load conditions is given in Section 1.0441. The effluent discharge to the Des Moines River from the bottom ash pond is given as 889,000 gpd (1.38 cfs) for maximum load conditions and 700,000 gpd (1.08 cfs) for average load conditions.

The discharge is continuous by weir overflow and will remain relatively constant during plant operation. The bottom ash pond, however, also is a collection basin for rainfall runoff and the plant storm drains. Consequently, the statement is made, "Discharge from the pond will be minimal except during periods of high precipitation," which refers to the fact that the rainfall runoff will increase the pond influent and correspondingly increase the pond discharge.

COMMENT 7: The issue of unprescribed water discharges into the Des Moines River is also neglected; among these would be sediment-laden rainfall runoff streams, and various contaminated leachates.

Surface runoff flows increase downstream within a watershed, the most pronounced flow being at the primary watercourse. Thus flood plains represent areas traversed by high runoff flows. At the OGS site the juncture of Avery Creek with the Des Moines River presents a classic example. The erosive potential of such runoff if augmented in most flood plain situations by the inherently alluvial nature of the soils present . . . Section 2.0131 of the draft EIS identifies the soil species at the proposed site as predominantly glacial till (Kansan) and various clays, both highly erodable soil types. While the EIS stipulates that landscaping will be done in Section 1.042, the exact nature of the practices if missing, as is comparative information of the runoff characteristics expected under the new regime as opposed to those of the original natural vegetative cover. This is a serious omission since alteration of drainage characteristics of a watershed has far-reaching impacts in terms of river sedimentation rates.

The runoff generated strictly by rainfall on the 795 acre site alone is of significant consequence. In terms of a concentrated one-inch rainfall, over 66 acre feet (22 million gallons) of runoff would be running from the site. With over 35 feet of topographical relief across the site (Section 2.0131), considerable erosive potential is generated and should be provided for with terracing, rip-rap, etc., as required. These considerations do not appear in the draft EIS.

RESPONSE: The OGS plant site covers 795 acres, whereas the Des Moines River basin above Ottumwa consists of 13,374 square miles. The plant site therefore makes up 0.001 per cent of the runoff area.

The plant site will be landscaped which will include grass to prevent soil erosion and control runoff. Area agricultural practices and tilled fields offer a much greater threat of soil erosion and adding to river sedimentation.

COMMENT 8: Conincident with these considerations is also the matter of river bank stabilization adjacent to the OGS site property. No mention is made in the draft statement of provisions to control bank slumping, erosion, and general stream meandering. Yet the location of the OGS at a bend in the river course would suggest such measures would be necessary to preserve the property. Impacts of such bank stabilization can be significant and analysis of methods to be employed is essential.

RESPONSE: The slopes along Avery Creek will have riprap to control erosion. Slopes and bottoms of ditches will be seeded under the sitework construction contract. The area between coordinates 2,259,940E to 2,260,795E and 400,405°N to 401,595 that are not paved, surfaced, or covered by structures will be seeded. There may be some temporary increase in turbidity of Avery Creek as a result of various construction activities. Because of the variability of precipitation, wind velocity, temperatures, and other factors, no attempt was made to quantify turbidity levels.

COMMENT 9: Another critical aspect of effluent waters deposited on the flood plain is the potential impact of these waters on subsurface aquifers typically found associated with river valleys. The draft EIS mentions the water bearing formations in the area (4 in number), attributing their recharge in a general way to "precipitation" (Section 2.023). Furthermore, the assumption is made that they are protected from contamination by any effluents by the presence of an overbearing aquiclude formation. This entire analysis is weak; exact recharge mechanisms for the aquiclude should be confirmed rather than assumed. The type of strata comprising the aquiclude is also relevant information found to be lacking in the draft statement. Contamination of ground water supplies is an ultra-important concern due to its irreversibility, and should not be dismissed so lightly.

RESPONSE: Generalized bedrock formations underlying the subsurface of the OGS plant site are depicted pictorally in Figure 2-12. Onsite testing by Atec Associates, Indianapolis, Indiana, have shown markedly different ground water conditions exist at various locations in the plant site area.

The presence and quantity of ground water can be expected to vary extensively in the upland portions of the site depending on elevation and the existence of a suitable aquifer material overlying rock. Water conditions within the soil layer were primarily influenced by the presence or absence of sand strata overlying bedrock.

In the lower areas the ground water level is primarily influenced by the water level in the Des Moines River.

The primary ground water aquifers according to well yields given in Table 1 are the surficial and Cambrian formations. The surficial, as stated above, is dependent on the presence of a sand strata above bedrock. This is not uniformly true throughout the plant site. Consequently, ground water is not available over the entire plant site by a continuous aquifer, but rather by isolated water pockets.

Test borings by Layne-Western Company, Inc., Ames, Iowa, were performed by the OGS site for determination of well placement for water supply. Test holes, however, did not indicate any promising ground water source existing onsite. The test holes bored through clay overlying mainly sandstone and limestone to depths of 30 feet which is deeper than the surficial aquifer would be if it existed.

The Camborian aquifer exists 1,200 feet below the ground surface. The yield is high, but the depth makes it impractical for use. Recharge to the Cambrian aquifer is from distant sources. The presence of various aqualudes between the aquifer formations form a barrier to recharge from surface precipitation and runoff.

TABLE 1. GROUNDWATER YIELDS TO INDIVIDUAL WELLS

Aquifer	Yield (gpm)
Surficial	100-500
Mississippian	less than 20
Devonian	no data
Cambrian-Ordovician	more than 1,000

Typical ground water quality of the aquifers existing in southeast Iowa is listed in Table 2. The data was collected by the Iowa Geological Survey and represents an estimate of the ground water quality in the area. The major influence on the ground water quality is the presence of limestone and gypsum formations throughout the region resulting in high hardness and sulfate concentrations.

Preservation of the ground water quality will be accomplished by the existing clay surface material in the coal pile and pond areas. The clay material averaging 5 feet thick provides an essentially impervious barrier to pollutant motivation. The recharge to the surficial aquifer below the clay surface is mainly through the river alluvium which will not be in contact with any plant waste or leachate. Therefore, no change in the ground water quality is anticipated.

COMMENT 10: The preliminary settling of the aqueous effluent streams in the proposed ash basins is an acceptable design if adequately considered. However, recognition of the irretrievable commitment of some 70 acres of land to this use is absent. Once the design life of these pits is exhausted and they are filled with settled precipitates, what is to come of them? The toxic nature of the solids comprising the fill precludes most future uses of these acres without extensive reclamation. The OGS draft EIS statement misses this issue, with a resulting implication that is in clear conflict with the "next use" stewardship of our land resource.

RESPONSE: Following the life of the generating station, land fill reclamation techniques will be carried out. The ash basins will be covered with approximately two feet of soil suitable to support vegetation. This reclamation technique will be subject to future regulations.

COMMENT 11: The matter of flood control provisions at the OGS is poorly addressed by the draft EIS statement. Mention is made of the design of the water intake structure for the 50-year flood, but no similar criteria are presented for the rest of the facilities.

Impacts of flooding of the site or parts thereof could range from mild to severe. No analysis is offered, but is well warranted. Flooding of roadway grades and other earthern structures would have serious implications in terms of potential erosion. Of worst consequence would be overtopping or outwash of the ash pond dikes by flood waters, liberating a host of toxic waters.

RESPONSE: All plant facilities will be protected against the 100-year flood of record. The intake structure will be designed for a maximum flood level of 663 feet. The operating floor level will be 665 feet. The top of the ash pond berms and roadways will be elevation 681 feet or above. The ash pond slopes also will be riprapped or seeded.

TABLE 2. GROUNDWATER QUALITY

Aquifer	Ca	Mg	Na + K	HCO_3	SO_4	Cl	F	TDS	Hardness Ca CO_3	No. of Analyses
Surficial										
ave.	108	31	21	295	169	11	0.4	552	395	8
range	84-143	20-41	11-28	218-390	22-287	3.5-17	0-1.0	440-726	304-525	
Mississippian										
(Upper) ave.	104	32	43	472	91	4.5	0.4	537	399	32
range	66-156	19-50	8.8-118	322-802	5.8-240	0.5-24	0-1.8	345-737	315-545	
(Lower) ave.	354	36	38	371	295	86	-	1,500	1,040	2
range	299-410	24-48	28-47	322-420	8-582	9-162	-	1,190-1,800	849-1,230	
Cambrian-Ordo										
ave.	84	34	267	298	476	124	1.7	1,160	349	8
range	78-92	26-41	247-283	283-317	455-500	100-148	1.0-2.2	1,100-1,220	322-388	

Data in mg/l

Iowa Geological Survey Water Atlas No. 4, "The Water Resources of Southeast Iowa," 1971.

COMMENT 12: The construction period for the OGS will be an environmentally critical one in terms of the existing potential for some uniquely severe impacts. During the construction phase the physical characteristics of the site are undergoing drastic changes, and in the interim are especially susceptible to degradation.

The clearing and grading processes expose and rearrange the soil strata of the area making a variety of impacts possible. Soil erosion is at a maximum potential at this time, and consequently so is siltation of adjacent watercourses. Section 4.0117 of the EIS acknowledges an increase in river turbidity during construction but makes no analysis of the resulting impacts. The degree of such turbidity increases is keynote in determining their adverse effect, but no such projection is made. Rather, the reference to "revegetation as soon as possible" is apparently assumed to remedy or prevent all impacts.

RESPONSE: Please refer to response to Comment 8.

COMMENT 13: The temporary structures associated with a large scale construction project also escape impact analysis . . . such things as temporary roadways and vehicle accesses, machinery storage areas, materials handling depots, etc. The impact of these on the fragile flood plain could be substantial but goes unmentioned. Removal of all temporary structures, particularly earthen ones, would be a crucial consideration, but may not be provided for.

RESPONSE: All temporary structures in the flood plain, including earthen ones, will be removed after they are no longer needed.

COMMENT 14: The legality of flood plain construction is a matter that needs explanation. Such construction requires by Iowa law permits from both the Natural Resources Council and the Iowa Conservation Commission. The former agency is conducting a three-phase approval program for the permit grant, the last phase of which is yet to be completed. Yet the EIS lists a "tentative approval" on January 6, 1976, in Section 9.04. No such "tentative" classification appears in the bylaws of the Iowa Natural Resources Council, suggesting a legal infraction by the initiation of clearing and grading operations on the OGS site in March of 1976. Further bending of the law appears to have occurred by anticipating the construction permit from the ICC, issued only in late May of 1976.

RESPONSE: The tentative approval as listed in the EIS at Section 9.04 was based on the information available at the time of publication. The Iowa Natural Resources Council responded to a review of the plans and specification with a letter dated January 7, 1976, which indicated that the project was "tentatively approved by the Iowa Natural Resources Council on January 6, 1976, subject to receipt of final certified plans and specification consistent with preliminary plans now on file with this office."

This review indicated that the proposed construction was in accordance with the requirements of the Natural Resources Council.

The authority of the Iowa Conservation Commission to require a construction permit is derived from Section 111.4 of the Code of Iowa. This section essentially requires a permit for the construction of any structure on or over any state-owned land or water. An application pursuant to this statute for a permit to construct the plant intake structure was filed on March 4, 1976. The Conservation Commission issued the permit for construction of the water intake structure on May 21, 1976. Actual construction of the intake structure did not commence prior to May 21, 1976. There was not "bending" of the law in regard to the construction within the intent or the scope of the permit requirement. The initiation of preliminary site clearing was in no way intended to restrict the Conservation Commission in its review of the adequacy of the water intake structure and the required design considerations needed to protect aquatic life.

COMMENT 15: Another important impact that is ongoing is the issue of the transmission lines and supporting facilities. Of central concern is the loss of prime Iowa farmland from productive use if these additional transmission facilities have to be built to transfer the power generated at OGS to other parts of the state. According to the draft, only two plans are under consideration: five 161 kV lines or one 345 kV with three 161 kV lines planned for overhead distribution on AC carriers. The amount of land taken out of productive use for this overhead distribution scheme figures roughly to 40 acre/mile,* so the total loss would be significant when extended over the proposed distribution network for the state. There was no mention of citizen input into the decision process involving route selection, nor any mention of how prices for the rights-of-way would be determined. No mention was made of the possibility of constructing higher voltage lines, thus cutting the right-of-way approximately in half, since for example, a single circuit 765 kV line has the load-carrying capacity equivalent to five single circuit 138 kV lines.

RESPONSE: See response to Comment 28.

See response to Comment 29.

Right-of-way payments are based on a percentage of the value of the land and on the number of structures for which an easement is being requested since the land beneath the line is still productive and can be used for crop production by the farmer.

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*Draft Environmental Impact Statement on Colstrip Electric Generating Units 3 & 4 . . . Energy Planning Division, Montana State Dept. of Natural Resources and Conservation; p. 250, Table 9-1, Vol. 1.

To initiate the legal process of line routing, an informational meeting date is requested from the Iowa Commerce Commission by the Company. After the Iowa Commerce Commission has determined the date, time, and place for the informational meeting, the Company then notifies all landowners, all parties holding an interest in affected properties and jurisdictional agencies who might be affected by any of the alternate routes. The informational meeting is held under the direction of the Iowa Commerce Commission.

At this informational meeting, the Company presents information to the attendees (landowners and interested parties, etc.) on the need for the line, the type of line that is being proposed, and discusses some of the representative routes which have been considered. At this meeting, the attendees have an opportunity to ask questions and make any suggestions that they feel appropriate. The Company is required to provide the best answer available at that time to any questions which might be asked.

Following this informational meeting, Iowa Southern evaluates the alternate routes with all information available, including that gained at the informational meeting. If a new, viable alternate route has been suggested at the informational meeting, this alternate will also be considered.

To construct a transmission line, permits must be obtained from the following agencies (and possibly others) to assure that the design meets their approval.

(1) Iowa Department of Transportation--State Road Crossings.

(2) County Board of Supervisors--County Road Crossings.

(3) Corps of Engineers--River Crossings.

(4) Railroad--Railroad Crossings.

(5) Pipeline Companies--Crossings.

(6) Conservation Commission--Crossing Their Property.

(7) FAA--Lines Near Airport.

(8) Iowa Commerce Commission.

There is considerable citizen input as well as input by other agencies.

COMMENT 16: Paragraph 4.01194. The composite noise level of 90 dBA is predicted to attenuate to 68 dBA outside the house and assumed to attenuate further to about 48 dBA inside the structure based on "general effect of most walls," they did not go to a house and check if its walls will absorb 20 dBA of sound; also no consideration was given for open windows during summer which would definitely increase the noise levels indoors; says noise level outside is noticeable but should be acceptable as a "temporary nuisance;" no time duration given for the term "temporary"--could be several years.

RESPONSE: There is no paragraph number 4.01194, and it is assumed that the comment is directed to paragraph number 4.01184 on page IV-4.

No field studies were conducted, rather the data published by experts were utilized which show that most houses will attenuate sound 20 dBA or more.* Consideration was given to windows being open, and as stated the interior sound level should be less than 48 dBA with windows closed.

Noticeable sound levels would occur during the day when various construction activities were in progress. These noticeable levels would be "temporary and intermittent" in the sense that they would not be continuous, but rather would vary as different equipment was in operation.

COMMENT 17: Paragraph 4.01196. Figure 4-1 on noise levels for one locomotive nearly incomprehensible; gives data points for noise levels of locomotive at various speeds but does not say at what speed the trains will be traveling. No inclusion of frequency of train deliveries; so inclusion of possible Doppler shifting of frequency to a more annoying value due to certain train speeds and distances.

RESPONSE: There is no paragraph number 4.01196 in the Draft EIS, and it is assumed that the comment concerns material presented in paragraph numbers 4.01186, 4.01187, and 4.01188 on page IV-4.

The speed of coal cars is given as 50 mph, and all other trains as 60 mph in paragraph 4.01186. Existing train operations are described in paragraph 4.01186, and delivery of construction materials by rail is addressed in paragraph 4.01187. Expected noise levels can be determined from Figure 4-1. A discussion of noise impacts is presented in paragraph numbers 4.01188 and 4.01189.

COMMENT 18: Paragraph 4.01197. Attempt to justify increasing noise levels due to spur line on basis of status quo argument--residents are already used to noise from Burlington Northern Railroad, so they should not consider the slight increase in noise levels as a nuisance; no figures given for estimated noise levels on spur lines and attenuation at nearby houses.

RESPONSE: There is no paragraph number 4.01197 and no statement that "residents are already used to noise from Burlington Northern Railroad, so they should not consider the slight increase in noise levels as a nuisance" was made in the Draft EIS.

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*Bolt, Beranek, and Newman, Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, NTID 300.1, U.S. Environmental Protection Agency, Washington, D.C., December 31, 1971.

COMMENT 19: Paragraph 4.01198. Sound levels in the surrounding community believed to be "quite tolerable" on basis of above "worst scenarios" yet above cases are incomplete and based on models that are not backed by hard data measurements.

RESPONSE: There is no paragraph number 4.01198, and it is assumed that the comment addresses paragraph number 4.01189.

The evaluation of construction noise impacts was made on the basis of data and models developed by recognized experts. These experts made numerous noise measurements and analyses under field conditions.

COMMENT 20: Paragraph 4.023. Statement says, "disturbance characteristics of noise are subjective," which is probably generally true but does not mention that the high frequency noise is more annoying to the human ear.

RESPONSE: As stated, a certain type of sound may be agreeable to one listener and an objectionable "noise" to another. It is probably true that a majority of people find loud, high frequency sounds annoying.

COMMENT 21: Paragraph 4.0231. Inclusion of four significant EPA noise level guidelines is good but the unit of dBA is not defined for the reader nor are there reference values to give the reader some idea of just, for example, what 60 dBA compares to in everyday experience; state that dBA values should not be thought of as discrete values since they are defined in terms of energy equivalents--confusing statement that sheds no light on the values at all.

RESPONSE: To define dBA it is first necessary to define "dB" or "decibel." A decibel is a measure of the power of the sound and is defined by the equation:

$$dB = 20 \log_{10} \frac{P_2}{P_1}$$

where:

P_2 = pressure of the sound to be measured in dynes/cm^2.

P_1 = reference sound pressure, usually taken to be a 0.0002 dynes/cm^2.

The term dBA refers to an A-weighted sound pressure level where the A-weighting factor modifies the frequency response of the measuring instrument to account for the frequency characteristics of the human ear.

For comparison, the following table lists typical sound levels.

Decibels		Decibels	
120	Threshold of feeling thunder	60	Noisy home
110	Elevated train	50	Average conversation
100	Loud street noise	40	Private office
90	Noisy factory	30	Quiet conversation
80	Noisy office	20	Rustle of leaves
70	Average radio	10	Soundproof roof

The effects of various dBA values also are discussed in paragraph number 4.01181 on page IV-3 and paragraph number 4.0231 on pages IV-22 and IV-25.

COMMENT 22: Paragraph 4.0233. The EIS has identified major producers of operational noise but does not include added noise when train with coal comes to the plant at the same time it is operated at full capacity.

RESPONSE: The discussion of the noise level during operation of the coal-handling system on the plant site included train noises.

COMMENT 23: Paragraph 4.0235. No real justification given for assuming Ottumwa residents will not hear OGS operational noise although almost undoubtedly true.

RESPONSE: Paragraph number 4.0235 does not address noise levels at Ottumwa. It is assumed that paragraph number 4.0237 is the correct reference for the comment.

Based on the predicted isopleth of noise values shown in Figure 4-5, operation noise from the generating station will not be heard at Ottumwa, Iowa, 8 miles away.

COMMENT 24: Paragraph 4.02311. The EIS attempts to justify high dBA readings by taking into account attenuation by grasses, trees, etc., giving misleading example where the effect of above on 1,000 Hz tone at 2.5 meters above ground but it doesn't say that the majority (or any) of the plant operation noise will be at 1,000 Hz, therefore, the real value could be higher or lower.

RESPONSE: The human ear is most sensitive to a 1,000 hertz tone, therefore, that value was used as input to the model analysis.

COMMENT 25: Section 6.12. Alternative Cooling Methods. This section states that the energy in the exhaust steam is "unrecoverable" and thus "waste" heat; this is certainly not true--the steam can sometimes be used to drive further topping cycle devices and could be used as a source of heat at the very least in the OGS buildings and possibly for the nearby town of Chillicothe. No mention is made of any studies at these possibilities.

RESPONSE: The Ottumwa Generating Station will utilize steam as efficiently as possible; and turbine exhaust steam will have such a low temperature and pressure that it will be impractical and uneconomical to use it for other applications around the Ottumwa area. The turbine exhaust steam pressure and temperature will range from only 1.5 in. of Hg absolute at 90 F to 3.5 in. of Hg absolute at 121 F. In contrast, the normal heating steam conditions to heat buildings at Ottumwa Generating Station will be about 115.3 inches of Hg absolute at 281 F.

COMMENT 26: Section 6.125. Table 6-5 on comparative qualitative ranking of each cooling alternative for a number of individual cooling systems characteristics is a good idea, but because the ratings are qualitative and they do not state how they decided on the index to rate the systems, therefore, it is misleading.

RESPONSE: The qualitative rankings shown in Table 6-5 are based on engineering and economic analyses of the different cooling systems. They represent an evaluation of present technology as well as economic and environmental considerations.

COMMENT 27: No mention of any disadvantages of evaporative coolers such as: discharge large quantities of humid air out over the environment; constantly emitting clouds and changing the average humidity in the local area; to prevent corrosion and fouling by organic growths, many different kinds of chemicals are added to the water and as blown out over the countryside, added to the environment; possible impact on crops in this area; or problems associated with this type of cooling scheme during the winter months. Section 6.126 states there will be "no thermal impacts as a result of wastewater discharges," but the water is to be recycled for cooling "as much as possible," implying some dumping at some future time.

RESPONSE: Cooling tower exhaust is a release of waste heat to the atmosphere in the form of vapor. Water vapor will be visible on cold days, but will dissipate into the atmosphere rapidly.

The following chemicals are planned to be added to the circulating water system.

(1) Sulfuric Acid: 8.58 gal/h of 66° Baumé (93%) sulfuric acid assuming

  (a) Makeup water has average water quality

  (b) 100 per cent l.f.

  (c) Alkalinity controlled at 25 mg/l in circulating water

(2) Chlorine: Feed rate will be variable depending on the season of year and actual operating experience. Assuming one 30-minute shock chlorination period per day and a 3 mg/l dosage, 208 pounds of gaseous chlorine per day will be fed.

Actual residual concentrations in the circulating water will be much less. As cooling tower blowdown is routed to the ash surge tank and then to the ash pond, there is not expected to be any chlorine residual in the plant discharge.

(3) Polyphosphate: Chemical used will be a polyphosphate compound. It is assumed that sufficient polyphosphate will be fed to maintain a 10 mg/l PO_4 residual in the circulating water.

The height of the cooling towers will be 42'-3" which is sufficiently low that any solids contained in the drift will precipitate from the atmosphere in close proximity to the cooling towers. Placement of the cooling towers with regard to prevailing winds will ensure the prevention of water vapor carrying over to offsite locations thereby reducing possible icing problems. Consequently environmental effects due to the cooling towers will be negligible to the offsite atmosphere.

Negligible mixing of the cooling tower vapor with stack gas to form acid rain is expected because of the difference in height between the cooling towers and the 600 foot tall stack. Dispersion modeling of the stack gas exhaust shows that the emissions will meet all air quality standards, and ground contamination will be negligible.

COMMENT 28: Section 6.081. Transmission Systems: The basis for decision making is system reliability and operation, system stability, economics, and coordination with future requirements. They are not analytically committed to finding the least environmentally damaging method.

RESPONSE: Environmental compatibility as well as economics of construction and operation are major considerations in the selection of alternate routes which will be evaluated and compared to determine the best specific route for each transmission line segment.

Transmission line rights-of-way will avoid cemeteries, quarries, airports and air landing strip facilities, monuments, parks, recreational areas, environmentally sensitive areas, historic sites, houses, and buildings.

Special efforts will be made to route lines along and parallel to the slope of hills rather than ridge line construction, to minimize line visibility.

Developed areas and areas of potential development will be avoided where possible.

Where reasonable and possible, the right-of-way will be confined to areas devoted to timber and pastureland use. Intensively cultivated areas will be avoided by the location of structures in fences or in wasteland wherever possible and reasonable to do so.

Densely populated areas will be avoided.

Specific items which are used to evaluate the feasible routes to determine the most desirable route are:

(1) The length of the line required by each alternate.

(2) The land use by category (intensive cropland, rotation cropland, pasture-hay land, woodland-wasteland, and other).

(3) A tabulation of structure locations for each feasible route is made based on the best information available at that time. That is, the number of structures which are located in each of the above land use categories, the number of structures that are in cross fences, the number of structures that are along fences and along roads are compared for the alternate routes.

(4) A tabulation is made of the number of dwellings which would be near the transmission line on each alternate route.

(5) The total cost of each alternate route and the power loss associated with each alternative is evaluated.

(6) Any potential inductive interference problems with other lines are considered.

After all this information has been assembled, the Company recommends the route which they determine is the most reasonable route. The basic premise used is to cause the least impact on the fewest possible people.

The final route is determined by the Iowa Commerce Commission as described in response to Comment 15.

Construction methods will be employed that minimize disturbances to roads, land, and improvements. During construction, rights-of-way will be maintained to avoid litter problems. Where temporary roads are required, the area will be graded to minimize soil erosion. Creek and small stream crossings will be constructed to avoid restricting the flow of water. Construction of rights-of-way will not affect ponds and shoreline wildlife habitat. Wherever possible, existing roads will be used and maintained during construction.

The type of construction which is proposed for 161 kV lines in the Ottumwa Generation Station area is a design called wood H-frame. Generally the structures will be 600 to 700 feet apart and located where feasible in uncultivated land or beside existing fences. The 345 kV transmission, which is presently being designed, is being designed to use tubular steel H-frame structures on approximately 1/4 mile spans. This type of construction was selected after considering wood H-frame, steel lattice, and steel Y structures. Concrete poles could be used in the H-frame structure in place of steel if advantages became apparent to do so.

COMMENT 29: Section 6.082. Transmission routing decisions section is devoid of discussion on citizen impact. No mention of estimates of land-use involved for the systems under consideration; no estimate of time involved for construction of transmission systems; questionable statements in 6.08212 on the impact of the transmission system on ponds and shoreline wildlife habitats. Input from the U.S. Fish & Wildlife Service should be sought on impacts to migrating birds.

RESPONSE: The actual land occupied by a typical mile of steel H-frame 345 kV line with no large angle structures in that mile would be approximately .0023 acres per mile. This is the actual land taken out of production due to the poles occupying the space. Since modern machinery is large and requires extra effort to maneuver around obstructions, an area approximately four feet around the entire structure and four feet either side of the area between the legs of the structure could be considered unavailable to modern farming techniques. Of course, if long grass is left in these locations between the poles of the structure, the structure provides wildlife cover for the area. This area, which includes the four feet around each pole plus the space between the legs of the structure, is approximately .039 acres per mile of 345 kV line with no large angles. It is recognized that some farmers plant closer to the structures than the four feet used above and some farmers do not plant as close. The four feet is an estimated average.

Actual land usage for a typical mile of 161 kV wood H-frame construction with no angles greater than .5° would be approximately .0012 acres per mile where the poles are actually occupying the space. Using four feet clearance around each pole and on either side of the area between the legs of the structure as land which is unavailable to modern farming techniques yields approximately .035 acres per mile of 161 kV wood H-frame. Drawings of 161 kV and 345 kV structures are shown in figure numbers 6-6 and 6-7 in the EIS.

As larger angles are required to be added to the lines to follow routes which are not straight or to deviate around buildings or other obstructions, the land usage increases above the previously listed values due to larger footings, wider structures, more structure legs, or anchors which are required for the angles. The total land usage as calculated for any specific route is peculiar to that route and the structures required for that route.

Since normal crop production and normal land usage can be continued underneath the line at all points with the exception of those listed above, very little land is actually removed from production. Experience has shown that crop production does carry on as before on the easement strip underneath the transmission line. If this area were an initially wooded area, trees should be trees which will not grow to great height and which will not become a hazard to the operation of the line. Low trees or shrubs which are for purposes of controlling soil erosion or providing game cover and beautification are permitted, but when such plantings are made, it is essential that the Company be informed of such replanting so that these plantings will not be damaged or cut by right-of-way maintenance crews.

The existence of transmission lines through a cultivated area does not prohibit aerial spraying in the area. The line does, of course, present another obstacle which the aerial sprayer must be aware of and avoid collision with.

The time required between the initial recognition of the need for a line and the planning, the engineering, the route selection and franchise approval for the line may require from two to four years or longer. The actual construction time required for a transmission line approximately 20 to 30 miles long is approximately six to seven months.

Construction of rights-of-way will not affect ponds and shoreline wildlife habitat because these areas are avoided by construction crews and equipment except for tall tree removal where a transmission line might pass directly over a pond or shoreline. Tall grass and small brush would be permitted to remain undisturbed in these areas. There has been no evidence that the presence of the electrical wires overhead at 345 kV or 161 kV causes any change in the habitat.

The Iowa Conservation Commission is notified of the informational meetings and of franchise hearings for transmission lines. At these proceedings they have the right to present any statement or objection concerning the impact of the line on wildlife, wildlife habitat, or migrating birds. At the informational meetings and franchise hearings which have been held on transmission lines in the OGS area, the impact on migrating birds have not been an objection. No adverse effects on migrating birds have been experienced with existing transmission lines nor are any expected with the proposed lines.

COMMENT 30: Section 6.083. Alternate transmission strategies are poorly treated. Systems under consideration are five 161 kV lines and one 345 kV with three 161 kV lines; absolutely no mention of higher voltage line possibilities, DC transmission strategies, and underground transmission.

RESPONSE: Many transmission alternatives were studied including systems which were totally 161 kV, systems which were totally 345 kV and several combination 345 kV and 161 kV systems, one of which was chosen as the final OGS area transmission plan.

DC transmission lines were considered for this project and rejected, since all of the lines are relatively short. With present day technology, a DC line is normally economical only for extremely long lines due to the high cost of the rectifiers and inverters which are required at the ends of the line. This termination cost is essentially the same whether the line is one mile long or 400 miles long. Underground transmission also was evaluated and rejected because 345 kV and 161 kV underground line usage is normally restricted to densely populated urban due to its exorbitant cost. We estimate the cost of underground transmission at 15 to 20 times the cost of overhead line construction.

Voltages higher than 345 kV were considered and rejected since they would offer no advantage in this situation and there are presently no transmission line voltages higher than 345 kV in Iowa. Voltages less than 161 kV were not considered beyond the interconnection of the 161 kV to the 69 kV system. It was found that when a 161/69 kV interconnection was made at OGS by a 161/69 kV transformer, the 69 kV flows were extremely heavy and resulted in extensive losses. Adequate system stability is also a problem with large synchronous machines on lower voltage transmission lines even when served by several additional low-voltage lines.

COMMENT 31: Section 4.024. Water Quality: Data given pertains to water flows and baseline concentrations in the Des Moines River and Avery Creek. No attempt was made to evaluate impacts.

RESPONSE: In addition to the impacts discussed in Section 4.024, the following expanded evaluation is provided.

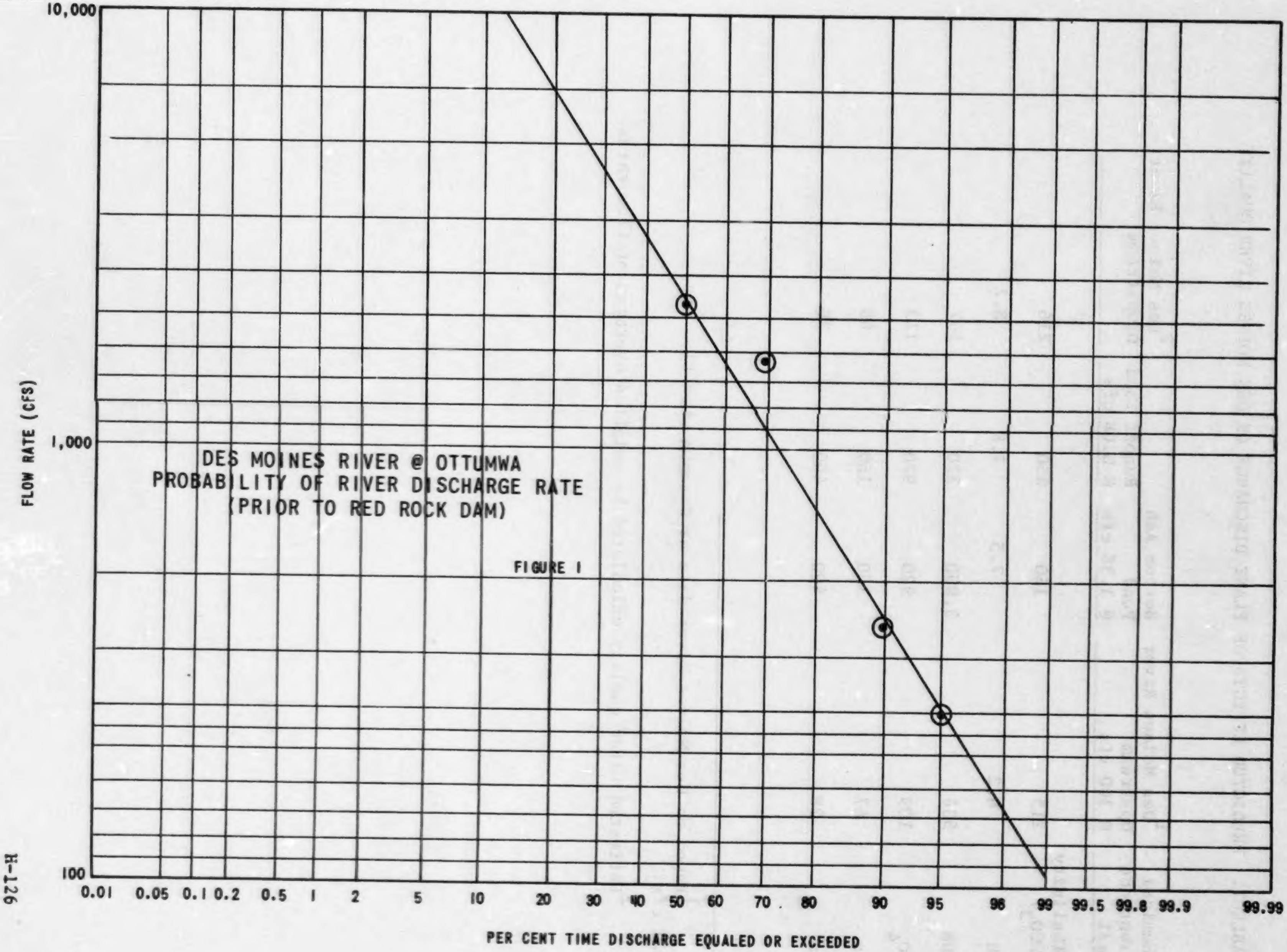
Discharges to the Des Moines River from the OGS plant site are from the bottom ash pond on an intermittent basis and the coal pile runoff pond as required following rain storms. The maximum average discharges are anticipated to be 1.38 cfs and 0.08 cfs respectively.

The flow of the Des Moines River is regulated upstream of the OGS site by Red Rock Dam, U.S. Corps of Engineers. The minimum flow guaranteed to the Ottumwa area is 300 cfs. Flow probabilities of the Des Moines River prior to operation of Red Rock Dam is shown in Figure 1, which indicates that historically the flow has exceeded 300 cfs approximately 95 per cent of the time without any flow regulation. Average 7-day low flow recurrence for 2-year and 10-year intervals are 370 cfs and 100 cfs respectively before operation of Red Rock Dam. Therefore, Red Rock Dam will help raise the flow rate less than 5 per cent of the time.

Assuming a low flow of 300 cfs for the Des Moines River, the dilution ratio for the combined OGS discharges to the river flow rate is 1.46:300 during periods of the worst possible conditions. The plant discharges therefore will makeup less than 0.5 per cent of the river flow at these conditions.

Neither the bottom ash pond nor the coal pile runoff pond will collect any significant amounts of trace metals from the coal. Table 1 (Runoff, Section 1.0451) indicates that the runoff pond wastewater will consist heavily of the common soluble substances which are not considered pollutants or harmful to man (although the water may become brackish). The settling pond retention period, however, will tend to precipitate a portion of the elements from the soluble state thus lowering the dissolved solids concentration of the effluent discharge.

Similar soluble elements are anticipated to be found in the bottom ash pond as is found in the runoff pond. Therefore, the bottom ash pond discharge will not contain trace metals and will only have concentrations of nonharmful soluble elements.



DES MOINES RIVER @ OTTUMWA
PROBABILITY OF RIVER DISCHARGE RATE
(PRIOR TO RED ROCK DAM)

FIGURE I

TABLE 1. PREDICTED EFFECTS OF PLANT DISCHARGE ON DES MOINES RIVER QUALITY

Chemical Substance mg/l	[1]Des Moines River Upstream @ 300 cfs	Bottom Ash Pond @ 1.38 cfs	Runoff Land @ 0.08 cfs	[2]Des Moines River Downstream
Alkalinity (HCO_3)	215	160	850	216
pH	8.2	7.5	7.8	8.2
TDS	536	3,000	320	547
SO_4	109	920	920	113
Ca	67	160	160	68
Na	28	400	400	30

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[1] Based on Des Moines River data at Ottumwa when flow was 321 cfs.

[2] Estimated water quality calculated by weighted averages of flow rates.

A hypothetical example of the effect of the plant discharges on the water quality of the Des Moines River downstream of the OGS plant site is given in Table 2. The example situation is for the worst possible case at maximum plant conditions and runoff pond discahrge and minimum river stage. The downstream concentrations were calculated by a weighted average of the makeup flow streams. This is only an example, as the quality of the river varies dramatically depending on the season, land use in the watershed area, operation of Red Rock Dam, and the meteorology.

The results are indicative of the dilution which would occur shortly downstream of the discharge locations for a combination of the worst possible conditions. However, the probability of the maximum discharges occurring in conjunction with low river flow is essentially nonexistent. The runoff pond is discharged only after rainfall and can be controlled to not discharge during periods of low river flow. The bottom ash pond discharge is also dependent on precipitation. Therefore, during drought periods and low river flows pond discharge will be minimal and evaporation may totally eliminate any discharge to the river.

COMMENT 32: No mention of trace elements is given and their impacts on hydrologic and biochemical cycles. Found to be of concern are: arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc.

RESPONSE: Chemical analysis of the coal supply is given in Table 1-6. The data listed are based upon average values from core samples.

Trace metal concentrations in the coal are given in Table 1-7. The total trace metal content of the worst possible coal supply is 0.10 per cent.

Many studies have been recently conducted to investigate the ultimate reaction in the coal burning process and to determine the areas of concentration in which to expect accumulation of the trace metals. To date the results have been inconclusive in applying the data to specific situations due to the vast differences in chemical compositions encountered in fly ashes from various coal sources and combustion processes. However, the general theories derived can be applied to arrive at logical estimates.

Studies by Block and Dams* analyzed the trace metal accumulation in coal ashes and found the results to be significantly different from the original coal composition. The trace elements, as a result of the study, were categorized into three groups based on their mass size distributions.

The first group (Mg, Al, Ca, Sc, Ti, Cr, Fe, Co, Rb, Ba, Hf, the rare earths, and Th belonging to the rock fraction of coal) are associated to large

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*Block, C. and R. Dams, "Study of Fly Ash Emission During Combustion of Coal," Environmental Science & Technology, Vol. 10, No. 10, Oct. 1976, pp. 1,011-1,017.

TABLE 2. EFFECTS OF PLANT DISCHARGE ON DES MOINES RIVER QUALITY

Chemical Substance mg/l	[1]Des Moines River Upstream @ 300 cfs	Bottom Ash Pond @ 1.38 cfs	Runoff Land @ 0.8 cfs	[2]Des Moines River Downstream
Alkalinity (HCO_3)	215	160	850	216
pH	8.2	7.5	7.8	8.2
TDS	536	3,000	320	547
SO_4	109	920	920	115
Ca	67	160	160	68
Na	28	400	400	31

---

[1] Based on Des Moines River data at Ottumwa on 10/21/57 when flow was 321 cfs.

[2] Estimated water quality calculated by weighted averages of flow rates.

particles and therefore buildup more in the bottom ash. The second group of elements (Cl, Cu, An, As, Se, Br, In, Sb, I, and Hg belonging to the organic fraction of coal) have a maximum concentration of small particles and are magnified in fly ash. A third group (Na, K, V, Mn, Ni, Ga, Mo, Ag, Cd, Cs, W, and Au) show intermediate behavior as a mass-size function.

Consequently, the coal analysis can supply an indication of elements anticipated to be present in the fly ash and bottom ash. Definite concentration, however, can only be determined by actual combustion of the coal and simulated ash collection methods implemented.

COMMENT 33: Section 4.0241. Since composition of the coal is not known, it is impossible to determine the chemical composition of wastewater discharges. All toxic substances, solids, and trace elements can cause changes in the resultant quality of the water affecting aquatic life, recreational use, and human consumption. Both the Des Moines River and Avery Creek will be affected. Sources of pollution would be in the form of dissolved solids from the ash basin, e.g., leaching.

RESPONSE: Please refer to response to Comment 31.

COMMENT 34: Section 1.0451. Runoff will be into a 2.2 acre basin. What will the impact of this basin do to the surrounding environment? Coal piles can also pose ecosystem threats in the way of leaching and dust.

RESPONSE: Rainfall runoff from the coal storage area will be to a runoff basin with a surface area of about 2.2 acres. This basin will be designed to contain the runoff from two consecutive 10-year, 24-hour rainfall events. Discharge will be to the Des Moines River by a manual control valve outfall.

Preliminary leachate tests of the coal conducted at the mine are as given in Table 1. The results indicate that the leachate maintains a neutral to slightly alkaline pH and a high concentration of total dissolved solids. Trace elements were not detected and only nonharmful substances were found in large concentrations.

The neutral pH will convert soluble substances to the solid state and precipitate in the runoff pond. This should lower the dissolved solids concentration prior to discharge.

The estimated discharge rate of 37 gpm after a rain amounts to 0.25 per cent of the Des Moines River at low flow. Although after a rain the river will be higher than low flow. An example of the effect of the runoff pond and the quality of the pond discharge is given in Table 2, Comment 33. Refer also to Section 4.024 of the EIS.

The clay subgrade of the runoff pond area is essentially impermeable and provides a barrier to possible pollutant contamination of potential ground water sources.

TABLE 1. COAL LEACHATE ANALYSIS

Chemical Constituent	Range	Ave
TDS	2,000-2,850	2,100
Hardness	830-920	890
pH	7.3-8.1	-
HCO_3	412-1,098	850
CO_3	0	
SO_4	880-959	920
Cl	8-35	19
NO_3	0.13-13.2	0.7
F	0.34-0.58	0.5
Na	321-503	400
Ca	56-264	160
Fe	0.03-4	1.4
K	6	
Li	0.10	
Mg	92	
As	0.00	
Se	0.00	
B	0.01-0.14	0.08
Zn	0.00	
Hg	0.000	
Cd	0.00	
Cu	0.00	
Pb	0.00	
Cr	0.00	
Mo	0.00	
Ni	0.04	
Al	0.00	

COMMENT 35: Section 1.0431. All plant wastes will flow into the bottom ash basin where settling out of suspended solids and pH equalization of plant wastes will occur. A complete inventory of wastes according to pH must be given to show how chemical balances will be maintained without added chemicals. Federal regulations (i.e., USEPA) impose limitations on the pH of liquid effluents from new large power plants, and the quantities of selected contaminates including chlorine in the various streams which may be discharged. pH ranges are also closely regulated.

RESPONSE: Bottom ash sluice water makes up approximately 85 per cent of the bottom ash pond influent. The free lime content of the western coal liberated during combustion will react to give an alkaline pH.

The remaining wastes which make up the remainder of the pond influent include plant runoff and miscellaneous drains which should have a pH range approximately neutral. Waste flows from the water treatment plant will fluctuate from acidic to basic, but ample storage is available in the pond for equalization.

Therefore, the bottom ash sluice should have the major impact on the pH of the pond. Provisions are included in the pond effluent discharge structure for CO_2 addition to lower the alkaline pH to the permissible range of 6 to 9 should this range not be met in the settling pond.

COMMENT 36: The ash basins are said to be self-sealing, but no defense of this statement is given. Without adequate protection soluble solids of all types are dissolved by the downward percolation of water. Effects of leaching may not be experienced for many years (5 to 10) but could show up and foul water supplies.

RESPONSE: Paragraph 4.02414 on page IV-29 discusses permeability testing conducted on the OGS site.

Please also refer to the response to Comment 9.

COMMENT 37: Section 2.08. Ambient Air Quality: Too much time was given to monitoring devices and techniques, and none about results of the study. Data should also contain baseline readings of hydrocarbons, ozone, CO, as well as expected trace elements in aerosols.

RESPONSE: Air monitoring methodology is discussed in Appendix D.

The pollutants monitored were those limited by federal and state regulations. Expected ground level concentrations of trace elements were discussed on pages IV-18 through IV-24.

COMMENT 38: On TSP's, the NAAQS is not included here to enable the reader to see the quality at the city site, also inadequate in reporting other air pollutants that could be expected at the plant site, i.e., heavy metals.

RESPONSE: Both primary and secondary standards for suspended particulates are shown in Table 2-21 together with monitoring data from the City of Ottumwa and the OGS site. Trace metals concentrations expected are discussed on pages IV-18 through IV-24.

COMMENT 39: Hydrocarbons are emitted during startup and shutdown, and should be mentioned; especially a projection of the carcinogenic polycyclic aromatic hydrocarbons resulting from incomplete combustion. Although not in high concentrations, they may combine photochemically with other atmosphere elements and produce additional carcinogenic agents as POM and benzo(a)pyrene.

RESPONSE: There will be little incomplete combustion during startup and shutdown. Under those operational conditions, there is excess air in the combustion system and combustion is almost complete. There will be some hydrocarbons released because there is no way to completely eliminate all incomplete combustion.

COMMENT 40: Section 1.04921. Not enough information given on furnace design and if it will reduce NO_2 emissions. State specifications and principles involved. No impact was given for NO_2 or other nitrogen oxides that are to be released. Both have adverse effects on human health, wildlife, and vegetation.

RESPONSE: A technical discussion of furnace design is beyond the scope of this report. Briefly, however, NO_2 emissions are controlled by regulating the combustion conditions within the furnace. The furnace manufacturer guarantees that NO_2 emission rates will meet all regulatory limits. Control of the combustion process in the furnace is the best method known for limiting NO_2 emissions.

Data given in Table 4-4 on page IV-16 show that the predicted concentration of NO_2 from Ottumwa Station will be far below the standard. Since the standards are based on non-toxic concentrations, no adverse impacts are expected on human health, vegetation, wildlife, or materials.

COMMENT 41: Sections 1.04923, 4.0218, and 6.09. Although particulates are spoken of in terms of a system, no justification of the choice of an electrostatic precipitator over other systems or the impact of the approximately 1 per cent particulates on the environment, including health and respiratory problems.

RESPONSE: Alternate particulate removal methods were discussed in Section 6.09 on pages VI-24 and VI-25. Reasons were presented why each system was not selected.

Paragraph 1.04923 on page I-28 described the electrostatic precipitator to be installed at Ottumwa Generating Station. This particulate removal system was selected because of its proven reliability, high efficiency, economics, and various engineering considerations.

COMMENT 42: There is a serious lack of information on the coal source and statistical evaluation of potential pollutant emissions which requires a more complete coal analysis than is given. The SO_2 emissions, for example, could exceed NSPS frequently, since the data are provisional.

RESPONSE: At the time the draft EIS was being printed, a coal contract had not been signed. A representative coal sample from the area where the coal would probably be mined was analyzed under worst case conditions. A contract has now been signed and the coal will be mined from the Cordero Coal Seam owned by Sunoco Oil. The specific analysis has been incorporated into the text. We are confident that the plant will meet New Source Performance Standards. To insure that the plant does meet the New Source Performance Standards, continuous monitoring equipment will be installed and must be certified using EPA procedures. The data collected by the monitors will be submitted quarterly to the Iowa Department of Environmental Quality. If a violation occurs, the Iowa Department of Environmental Quality or EPA could take legal action against Iowa Southern Utilities.

COMMENT 43: Needed are specifics on coal type, and various models and efficiencies of SO_2 removal systems, and impacts of SO_2 that will be released. No mention has been made of the adverse health, vegetation, material destruction, and effects of sulfur emissions.

RESPONSE: Estimated concentrations of sulfur dioxide from the Ottumwa Generating Station are given in Table 4-4 on page IV-16. As shown, expected sulfur dioxide concentrations will be well below the federal standards. Since federal standards are based on safe concentrations, it must be concluded that there will be no adverse effects on health, vegetation, or materials.

COMMENT 44: No assessment of toxic trace elements or toxic compounds is made. Possible elements emitted that cause greatest harm: arsenic, antimony, barium, cadmium, chromium, copper, fluoride, mercury, lead, selenium, thorium, uranium, and zinc. All of these should be analyzed, their emission rates and impacts should be evaluated and mass balance presented based on Radian Corporation's studies for EPA.

RESPONSE: Expected concentrations of trace elements are discussed on pages IV-18 through IV-24. Table 4-7 shows predicted ground level concentrations of arsenic, mercury, and selenium compared to limits of human exposure. Expected concentrations are far below the limits tested.

Table 4-9 gives the maximum emission concentractions of trace elements in fly ash expected from Ottumwa Station compared to limits of human exposure.

COMMENT 45: Estimations of damage impacts of all these air pollutants should be given so the public can be informed. Crop and vegetation damage, soiling, maintenance and cleaning costs, degradation of rubber, stone, concrete, and glass are all very real and need to be evaluated.

RESPONSE: As discussed in Section 4.02, regulated pollutants, i.e., sulfur dioxide, nitrogen dioxide, and particulate matter, will meet federal and state standards. No adverse impacts are expected on vegetation or materials.

(1) Sulfur Dioxide. A comparison of threshold concentrations of sulfur dioxide reported to cause vegetation damage, estimated sulfur dioxide maximum concentrations with OGS operating, and air quality standards as given in Table 1. As is shown, expected sulfur dioxide levels will be well below those reported to cause damage to vegetation and will meet standards.

The low ambient concentrations of sulfur dioxide predicted will not cause any cleaning problems; or degration of rubber, stone, concrete, or glass.

(2) Nitrogen Dioxide. Broad-leaved plants often show necrotic lesions after exposure to 2-10 ppm of nitrogen dioxide. Only limited studies have been made with chronic injury, but growth retardation occurs at 0.5 ppm. Tomato, tobacco, and bean respond to nitrogen dioxide.

The annual average concentration expected as a result of the operation of OGS is only 0.0007 ppm of nitrogen dioxide. This concentration is far below levels reported to cause necrotic lesions or retard the growth of plants.

(3) Particulates. There are varied reports in the scientific literature concerning the effects of particulates on vegetation. The lack of information on damage to vegetation caused by particulates suggests that particulate emissions from a properly operated coal-fired generating station will not adversely effect flora in adjacent areas.

Alfalfa, bean (tendergreen bush), carrot (Chantenay), tomato, cotton, tobacco, celery, cucumber, squash, cabbage, cauliflower, eggplant, onion, soybean, and sweetpea (Spencer hybrid) were sensitive to fluoride concentrations more than 10 ppb.

The maximum ground level concentration expected at the OGS site is 0.018 ppb. This concentration of fluoride is considerably less than the concentrations reported to injure the plants listed. No adverse effects on vegetation is anticipated as a result of fluoride emission from OGS.

COMMENT 46: No information is presented in the preliminary draft EIS on the project's impacts on human health. It is known that the discharge of some air pollutants, most notably SO_x, NO_2, water vapor, fluorides, and particulates, can cause respiratory ailments or aggravate the conditions of eye irritation, heart disease and other internal disorders. Despite the claim

TABLE 1. COMPARISON OF THRESHOLD SULFUR DIOXIDE CONCENTRATIONS REPORTED TO CAUSE VEGETATION DAMAGE WITH AMBIENT AIR QUALITY STANDARDS AND ESTIMATED MAXIMUM OTTUMWA STATION CONTRIBUTIONS

Exposure Period	Reported Threshold Concentration µg/m^3	Ambient Air Quality Standards µg/m^3	Maximum SO_2 Concentration From OGS µg/m^3
1-hour	1,963[a]	926	128
3-hours	--	1,300	72
8-hours	1,178[a]	--	--
8-hours	860[b]	--	--
24-hours	785[a]	159	24
24-hours	300[b]	159	24
1-week	445[a]	--	--
1-month	265[a]	--	--
1-year	79[a]	40	1.4
Annual Mean	85[b]	40	1.4

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[a] Linzon, S. N., "Effects of Sulfur Oxides on Vegetation," The Forestry Chronicle 48: 1-5, 1972.

[b] Hindawi, S. J., Air Pollution Injury to Vegetation, U.S. Department of of Health, Education, and Welfare, Public Health Service, National Air Pollution Control Administration, Raleigh, N. C., 1970.

that the plant will not cause air pollution levels exceeding ambient air quality standards, no evaluation was made of the effect that air quality degradation resulting from the project will have on those persons working in the area and those persons living in the nearby area.

RESPONSE:

(1) Sulfur Dioxide, Nitrogen Dioxide, and Fluorine. The maximum expected concentrations of sulfur dioxide, nitrogen dioxide, and fluorine and the limits for human exposure area as follows.

Pollutant	Maximum Expected Concentration mg/m^3	Limits for Human Exposure* mg/m^3
Sulfur dioxide	0.13	13
Nitrogen dioxide	0.11	9
Fluorine	0.03	2.5

From the data listed, it is evident that the maximum expected concentrations of sulfur dioxide, nitrogen dioxide, and fluorine will be much less than the limits for human exposure.

(2) Particulates. The maximum expected concentration of particulates is 0.003 mg/m^3 (1-hour ambient concentration). There are no limits for human exposure established for particulate per se; however, there are limits for dust which is a particulate. These values are as follows.

Substance	Limits for Human Exposure* mg/m^3
Inert or Nuisance Dust:	
Respiratory fraction	5
Total dust	15

It is appraent that the particulate maximum concentration will be less than the limits for human exposure for dust which is a particulate.

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*Title 29, Code of Federal Regulations, Part 1910.1000. Established by OSHA for an 8-hour shift.

(3) Water Vapor. The design of modern cooling towers minimizes drift from the units. At the Ottumwa Generating Station, drift from the cooling towers will not extend beyond the boundaries of the plant site. Furthermore, water vapor generally is not considered toxic.

(4) Trace Elements. As shown in Table 4-9, the predicted concentrations of trace elements will be for below the concentrations considered the occupational limits of human exposure based on an 8-hour shift.

On the basis of available data, no adverse effects are expected with persons working in or near the OGS site as the result of the emission of air pollutants. Ambient air standards for trace metals have not been established by EPA, but research is being conducted to evaluate possible health hazards and crop damage resulting from low level concentrations of trace elements.

COMMENT 47: Section 2. A diffusion modeling analysis has been presented in the draft EIS to show that the discharge of air pollutants will not violate the ambient air quality standards of the region. However, the discharge of pollutants into the air, such as sulfur dioxide, nitrogen oxides, and fluorides can have an effect on the agricultural economy of the affected area. Specifically, the impact of these pollutants on crops in the area should be dealt with. Why is no information contained in the preliminary draft EIS pointing this out relative to EPA's own reports on crop sensitivity?

RESPONSE:

(1) Sulfur Dioxide. Referring to Table 1 which was part of the response to Comment 44, it is evident that the expected concentrations of sulfur dioxide will be well below the threshold concentrations reported to cause damage to vegetation. Because of the low concentration of sulfur dioxide predicted, no injury to crops in the vicinity of Ottumwa station is anticipated.

(2) Nitrogen Dioxide. Damage to vegetation may occur as the result of exposure to high concentrations of nitrogen dioxide. The following threshold concentrations of nitrogen dioxide have been suggested for visible injury: 18,800-22,000 $\mu g/m^3$ for 1 hour; 4,324-6,580 $\mu g/m^3$ for 8 to 21 hours; and 1,800 $\mu g/m^3$ for 48 hours (1). Limited data suggest that exposure for periods over 48 hours of lower concentrations may adversely affect some plants (2). It has been reported that the yield of oranges decreased and leaf loss increased after exposure to 470 $\mu g/m^3$ of nitrogen dioxide for 8 months (3).

It has been observed that the rate of uptake of carbon dioxide in oats and alfalfa was reduced following exposure for 0.75 to 1.5 hours to 940 to 1,316 μg/m^3 of nitrogen dioxide (4). It was doubted that significant growth reductions would occur from the inhibition of carbon dioxide uptake without foliar damage.

The estimated maximum ground concentration of nitrogen dioxide resulting from the operation OGS is 110 μg/m^3. This concentration is far below the levels discussed in the preceding paragraphs that may have adverse effects on vegetation including crops.

(3) Fluoride. Sensitivity to injury from flouride exposure has been reported for a number of species of plants. Exposure for 7-to-9 days to 5-to-10 ppb concentration of flouride injured corn, pepper, clover, barley, flax, oats, rye, apple, and peach.

COMMENT 48: Sulfur dioxide and fluorides especially have been shown to have an adverse effect on crops such as soy beans, alfalfa, oats, red clover, wheat, and rye, even below ambient air quality standards. NEPA directs that the economic impacts of such possible crop damage from these air pollutants must be dealt with.

RESPONSE: Please see response to Comment 46.

COMMENT 49: Equally important, it should be determined what impact the discharge of air pollutants will have on wildlife habitats in areas near the plant site. More specifically, a review of animal and bird species which might be affected by possible deterioration of the plant communities caused by these pollutants in addition to any direct effects.

RESPONSE: Wildlife habitats are not expected to be affected by pollutants from OGS. The concentrations predicted are below those considered toxic to vegetation.

See response to Comment 46.

COMMENT 50: A discussion of the possibility of "acid rain" resulting from sulfur dioxide would also be appropriate and should be included.

RESPONSE: Sulfurous and sulfuric acid will be formed during rains by the dissolution of sulfur dioxide. This process is similar to that taking place in a wet sulfur dioxide scrubber except that no lime or caustic is present. One of the major governing factors of sulfur dioxide removal in such scrubbers is the liquid to gas ratio (L/G). The latest state-of-the-art in such scrubbers require a L/G ratio of 100 for 90 per cent sulfur dioxide removal. To compare the effective L/G in a rain storm with that existing in a scrubber, it is assumed that the plume is dispersed over a 10 degree sector with an average depth of 2,000 feet. The volume of gas to be scrubbed over a one square foot area is then 2,000 cubic feet. Assuming a one-inch rainfall, the amount of water for the scrubbing action is 1/12 cubic foot for this one square foot area. The L/G of the rain falling 2,000 feet by converting cubic feet to gallons is then about

$$L/G = 1/12 * 1/2 * 7.481 = 0.312 \text{ gal/MCF}$$

The sulfur dioxide reaction rate would then be about half a per cent of that in a 100 L/G scrubber. For purpose of conservatism, it is assumed that 10 per cent of the sulfur dioxide is dissolved by rain.

To estimate the acidity resulting in the rainwater, also assume:

(1) One inch rainfall in one hour.

(2) A 10-mile per hour wind speed at the surface.

(3) The effective dispersion velocity is that at actual stack height.

(4) Stable atmospheric conditions.

(5) Sulfur dioxide is converted to sulfuric acid and the stiochiometric ratio is 1.

(6) Sulfuric acid is completely dissociated to hydrogen ion and sulfuric ion.

At stack height, the effective wind velocity, u, is

$$u = 10 \frac{(650)}{35} 0.5 = 44.38 \text{ mph}$$

The sulfur dioxide emission at maximum load is about 8,412 pounds per hour. The area, A, of the 10 degree sector over which the sulfur dioxide is dispersed in one hour is:

$$A = \frac{\Pi \ (44.38)^2}{36} = 171.88 \text{ square miles}$$

One gram mole of sulfur dioxide is converted to one gram mole of sulfuric acid which dissociates to two gram moles of hydrogen ion. The number of gram mole, NGM, of hydrogen ion per square mile in one hour is:

$$NGM = \frac{8,412 * 0.10 * 453.6 * 2}{32 * 171.88} = 138.74$$

The volume of rainwater, V_R, falling per square mile during the one inch rain is:

$$V_R = \frac{(5,280)^2}{12} * 28.32 = 65.79 \times 10^6 \text{ liters}$$

The maximum approximate molarity of the hydrogen ions in the acid rain would be:

$$\text{Molarity} \cong \frac{138.74}{65.79 \times 10^{6}} = 2.11 \times 10^{-6}\ \text{M}$$

The approximate pH of the acid rain is about:

$$\text{pH} \cong -\log (2.11 \times 10^{-6})$$

$$\cong \quad 6$$

on near neutral. This is about the same pH of rain due to the dissolution of carbon monoxide in the atmosphere.

COMMENT 51: The draft EIS does not discuss the impact of OGS on potable downstream uses of Des Moines River water. The statement should provide an inventory of downstream uses, most important being that of drinking water quality. Not only should present uses be considered, but also projected uses.

RESPONSE: There should be no adverse impacts on potable water quality downstream from OGS. Please refer to the response to Comment 30.

COMMENT 52: The generating station's effect on the aquatic ecology downstream should also be considered and particularly should include consideration of game fish populations.

RESPONSE: Please refer to the discussion for Comment 30.

As pointed out, effluent discharges will be intermittent and only during periods of heavy rainfall when there is a high river flow. The dilution of the discharged effluent will greatly reduce the possibility of any adverse effects on game fish or any other aquatic fauna or flora. The discharged effluent also will meet all applicable water quality standards.

COMMENT 53: The draft EIS does not treat the ecological impacts of the extraction of coal and its transportation to the site. Questions which arise are, "What effects will the mining of Western coal have on the ecology there?" "Will the strip mined land be reclaimed?" "If so, to what extent can it be reclaimed?" "What evidence is there to support these findings?"

RESPONSE: The environmental impacts of mining and transporting coal have been extensively evaluated in other studies of the Powder River Basin coal fields in Wyoming, the source of coal for OGS. For a complete discussion of impacts of the strip mining operations and related activities, the reader is referred to the following reference.

Department of the Interior, Interstate Commerce Commission, Department of Agriculture, "Final Environmental Impact Statement--Development of Coal Resources in Eastern Powder River Basin, Wyoming," October, 1974.

COMMENT 54: The impacts projected by the draft EIS for the terrestrial plant and animal communities can in no way be interpreted as a "detailed" analysis. The statement says nothing more than, in effect, there will be considerable habitat destruction resulting in displacement and elimination of certain species. Sufficient information exists in the relevant literature to project specific species-by-species impacts given the description of the area in Paragraphs 2.06 and 2.07. An assessment is needed of the plant communities and the proportion of these plant communities and species that will be destroyed during construction. This could be facilitated by plotting construction activities on a vegetation map. An estimate of the decline or displacement of each species could be made by using the habitat requirement data, available in the relevant literature of each specie in question.

RESPONSE: As stated in paragraph 2.0731 on page II-96, most of the acreage of the plant site was in agricultural production. Of the total 795 acres, 536 acres were planted in crops and 259 acres were in pasture. Approximately two acres of grassland and three acres of forest will be lost which will represent only about 0.6 per cent of the total site area. There will not be "considerable habitat destruction," but a few species will be displaced or eliminated from the site. A quantitative estimate was not attempted, but it is the opinion of expert consultants from Iowa State University that the losses will be minor. The use of 67 per cent of the site for the cultivation of crops has already caused the displacement or elimination of native flora and fauna from most of the acreage.

COMMENT 55: Further detailed analysis should be made of the effects of the food web from each herbivore by using the principles of the food web. The food chain relationships are of the utmost ecological importance because they define the dependence of each species on all other species. The impact statement should discuss this interdependence.

RESPONSE: The adverse effects of the proposed project should be very minor. Since most of the site is used for agricultural purposes, there is little habitat suitable for resident herbivores. After the generating station is constructed, there will continue to be grassland and trees available on the site to transit species. There are adjacent areas that can accommodate any herbivores displaced. An analysis of effects on the food chain is not indicated.

COMMENT 56: Other considerations needed in the EIS include the importance of the area to migrating waterfowl and in what ways they will be affected. Concern should not be centered solely on the construction area, but also consider the possibilities for impacts on the surrounding areas (e.g., diminished use of the riverine habitat and impacts on breeding populations).

RESPONSE: The operation of Ottumwa Generating Station should not affect the use of the Des Moines River by waterfowl. The intake and outfall structures will occupy a very small area of the river and will not preclude use of the river by birds.

The intake water velocity will be about one foot per second which is less than the river velocity, and the wastewater discharged will meet water quality standards. Neither of these factors should have an adverse impact on waterfowl water use.

COMMENT 57: Other potential wildlife impacts should be discussed: deer population status and effects on range and patterns of movement should be determined, the value of the area to birds of prey and wide ranging mammalian carnivores, and the functions of the area for migratory birds.

RESPONSE: During construction, about three acres of wood will be removed. This would represent the primary habitat for deer. This loss of habitat would reduce the deer population at the site area; however, they would very likely move into other nearby areas. The white-tailed deer is found throughout Iowa as well as most of the United States, except desert regions.

A number of species of other small mammals, birds, amphibians, and reptiles also utilize the site to some extent. Since the site was used primarily for crop production and there were no sensitive habitat areas, e.g., wetlands, it is anticipated that these species will be displaced to other nearby areas with similar or better habitat characteristics.

COMMENT 58: Very little information is presented on the impacts of the project on the aquatic systems of the Des Moines River and Avery Creek. It is stated that erosion will occur during plant construction and that it will cause a temporary increase in turbidity of these waters. A prediction of soil loss can be made by engineers and should be done. The level of turbidity which will be reached in Avery Creek and the Des Moines River, and how long it will last, should be stated and quantified.

RESPONSE: As a result of clearing and construction activities there will be some increase in the turbidity of Avery Creek because of runoff from the site. The amount of runoff will depend upon a number of factors including precipitation, wind, temperature, and the nature of the construction activities. Because of the variability of these factors, it is not possible to make quantitative predictions of soil losses and turbidity levels.

COMMENT 59: The long range effects of suspended sediment on benthos and primary productivity should be assessed. Avery Creek is very important as a spawning ground for game fish populations. Construction activities are bound to have a direct detrimental effect on benthos plankton and larval fish populations. This obvious impact should be quantified and discussed. The future of game fish populations in the Des Moines River as affected by the OGS project should be thoroughly covered in the EIS.

__RESPONSE__: There will be no long range effects of suspended sediment on benthos and other aquatic organism in Avery Creek or the Des Moines River. Only during some of the construction phases will there be an increase in suspended solids and sedimentation in Avery Creek because of runoff from the site. Any resulting adverse aquatic impacts will be temporary and limited to a portion of the construction period.

It should be noted that initial engineering studies showed the desirability of rerouting Avery Creek on the plant site to best utilize the area. After investigations were made of Avery Creek by University of Iowa scientists, the decision was made not to alter the course of the creek in order to preserve the existing habitat.

Avery Creek has limited use as a spawning, recruitment, and feeding area. These activities generally are associated with high river levels in June and July. Characteristically, the water level of the creek fluctuates frequently, and the stream bed becomes completely dry occasionally.

__COMMENT__ __60__: The draft EIS states that thermal pollution due to the project will be "minimal." The statement never specifies what the temperature of the wastewater discharged to the river will be at various times of the year and even if it will exceed state water quality standards. According to Iowa Water Quality Standards, in Class B streams such as the Des Moines River no heat shall be added that will cause an increase in temperature of over 5 F and not more than a 2 F increase per hour. The total temperature can never rise above 90 F. The preliminary EIS provides no information, facts or analysis that show if they will be able to comply with this.

__RESPONSE__: The cooling tower blowdown is used as bottom ash sluice prior to being wasted to the bottom ash pond in the ash sluice stream. The blowdown is drawn from the cool side of the cooling towers, so thermal discharge to the ash pond is solely from heat obtained in sluicing the bottom ash.

The pond has an 80-day retention period and calculations show that even during summer conditions of high humidity and temperature, the pond water will have a temperature not greater than 5 F above ambient surface water temperature. Consequently, since all the heat is dissipated in the ash pond prior to discharge to the Des Moines River, there is no need for a diffuser type discharge structure within the river.

Standards established for Class B fresh warm water designations in the state of Iowa require "no heat shall be added to interior streams that would cause an increase of more than 5 F." The ash pond discharge is in compliance with the standards and will, therefore, not form a thermal barrier in the Des Moines River which would block normal passage of aquatic animals or fish up and down stream.

COMMENT 61: Other specific questions should be answered. How does the temperature of the wastewater discharged compare to the normal temperature of the river water? What effect will the wastewater discharged have on the river water temperature and will the temperature change affect the ecosystem (e.g., how will it change game fish populations and larval fish populations in these waters)? What will be the overall quality of the wastewater discharged to the river? What will be the BOD, heavy metals, and other parameters of the discharge water and how will this affect DO levels in the river? What is the threat of heavy metals and salts from the ash ponds to aquatic life of the river? The possibility of the heavy metal ions increasing by biological magnification must also be considered in detail.

RESPONSE: Please see responses to Comments 30, 33, and 59.

COMMENTS 62: In conclusion, it should be emphasized that the NEPA Court cases of EDF vs Corps of Engineers, Daly vs Volpe, and Brooks vs Volpe, to name a few, hold that the environmental impact statement cannot be structured in the form of "findings," but rather must be an objective presentation of all the facts, pro and con. The language in much of the preliminary EIS does not lend itself well to such an interpretation.

Specifically, the description of the present site condition violates the requirement of objectivity. The tone of the writing tends to downgrade the importance of the area as a natural site rather than presenting the issue objectively. The use of the words "typical" and "disturbed" in Section 4.0111 does not objectively describe the environmental value of the area to humans and wildlife. The tone insinuates that it isn't even a part of the natural environment because it has been disturbed, indicating that the authors believe the "natural environment" there isn't worth worrying about. This is biased treatment and is false. The natural environment of much of Iowa has been at some period "disturbed." Planned disturbance and control of vegetative succession is, in fact, a valid wildlife management technique. The tone of the draft EIS should be changed such that it presents an objective view of the facts and alternatives.

RESPONSE: Scientists from Iowa universities have attempted to present an objective description of the existing environment of the Ottumwa Generating Station site, and the probable impacts of the proposed project. It is a fact that most of the acreage on the plant site is presently utilized for agricultural purposes and only a limited amount of natural habitat is present. As stated in paragraph 4.0112, there will be a loss of about three acres of forest and two acres of grassland. Some species of mammals, birds, amphibians, and reptiles will be displaced into other areas and there will be local population depression for some species (paragraph 4.0113). These are adverse impacts which likely will occur; however, it is impossible to construct and operate a large electric generating station without incurring some adverse impacts. These adverse impacts must be weighed against the benefits to be derived from the generation of electric power.

The words "typical" and "disturbed" do not appear in paragraph 4.0111.

We have, to the best of our abilities and resources, complied with Section 102(2)(c) of the National Environmental Policy Act. Where specific information exists in regard to the proposed action, we have included it in the statement. If the information does not exist, we have so stated.

REFERENCES

1. Thompson, C. R., D. T. Tingery, and R. A. Reinert, "Acceptable Limits for Air Pollution Dosages and Vegetation Effects: Nitrogen Dioxide," Paper No. 74-227 presented at the 67th Annual Meeting of the Air Pollution Control Association, Denver, Colorado, June 9-13, 1974. Air Pollution Control Association (Pittsburgh), 22 pp. (1974).

2. Hill, A. C. and J. H. Bennett, "Inhibition of Apparent Photosynthesis by Nitrogen Oxides," Atmospheric Environment, 4: pp. 341-348 (1970).

3. Tayor, O. C., "Injury Symptoms Produced by Oxidant Air Pollutants," Handbook of Effects Assessment--Vegetation Damage, edited by N. L. Lacosse and W. J. Moroz, Center for Air Environment Studies, Pennsylvania State University, University Park (1969).

4. Bennett, J. H. and A. C. Hill, "Inhibition of Apparent Photosynthesis by Air Pollutants," Journal of Environmental Quality, 2(4): pp. 526-530 (1973).

RESPONSES

COMMUNITY ACTION RESEARCH GROUP

COMMENT 1: It should be noted, however, that CARG believes substantially more comment could have been provided had resources been available. Because this unfortunate situation exists for most citizen organizations--and CARG is in perhaps the best financial conditions of any such group in Iowa--EPA and other federal agencies are deprived of valuable input and participation from citizens, not only in terms of the EIS review process but also in terms of identifying areas of controversy and assisting the agency in its evaluation of a project at its inception.

RESPONSE: Your comment regarding Federal subsidy for CARG review of the Ottumwa Generating Station Draft Environmental Impact Statement (EIS) is inappropriate. While we realize that financial and time allocation problems can be incurred in voluntarily reviewing an in-depth, broad-based document such as an EIS, the solution is not Federal financial assistance for such public review for the following reason: Potential bias may result from Federal financial assistance of one group as opposed to another group or individuals participating in a public review process. Public review of Federal agency actions, therefore, should always remain a voluntary effort. Furthermore, it seems hardly necessary to point out that Federal assistance, while it might stimulate additional public review, could hardly be extended to every individual or group participating in or reviewing a Federal project.

Additional factors limiting Government financial assistance are the stringent regulations governing Federal procurement contracts for services or products. Financial payment or reimbursement for a citizens group, such as CARG, for a public review effort would be subject to such contracting regulations and would involve a lengthy process of competitive bidding and Federal evaluation of proposals submitted and finally grant award for the technically acceptable and most cost-effective proposal.

COMMENT 2: "The need to ensure a complete record" has been cited in decisions granting petitions to intervene in agency proceedings. New York Department of Environmental Conservation, Opinion on Motions to Intervene, File No. 2833, November 19, 1975, at 3. There are several reasons why the presence of intervenors is helpful in ensuring a complete record. "Courts and commentators have increasingly recognized that substantial benefits may be accrued from the participation of groups such as NRDC (Natural Resources Defense Council), petitioning to intervene, which force not only the parties but also the hearing officer to consider a broader range of argument and interests than might otherwise receive consideration." *Id.*, at 12-13. *See generally* E. Gellhorn, *Public Participation in Administrative Proceedings*, 81 Yale L.J. 359 (1972); Comment, *Public Participation in Federal Administrative Proceedings*, 120 U. Pa.L.Rev. 702 (1972). The same logic applies to an agency's planning and evaluation procedures as well, especially in the NEPA review process.

RESPONSE: EPA, in general, agrees with your comment regarding the beneficial presence of intervenors in ensuring a complete record for public participation in administrative proceedings. However, EPA believes that the benefit of an intervenor is due, at least in part, to the objectivity of the intervenors and as such EPA does not wish to jeopardize this objectivity by financial assistance. We might add, at this point, that if gross deficiencies exist in a government-sponsored document or review of proposed Federal action, such deficiencies are better remedied by more efficient and knowledgeable Governmental in-house preparation processes.

COMMENT 3: With this standard of strict compliance in mind, and in view of the magnitude of the proposed project (the direct costs of which will likely exceed two billion dollars over its 30 year life-time when the total fuel and maintenance costs are added to the plant's fixed costs), CARG has examined the EIA (see footnote on page one) and found it to be considerably less than a full disclosure document. By comparison, the Department of Interior has developed a set of guidelines which if followed in writing an EIA, would fulfill the standard of strict compliance. See Guidelines for the Preparation of Environmental Reports for Fossil-Fueled Steam Electric Generating Stations, prepared for the U.S. Department of Interior's Office of Water Research and Technology and Office of Environmental Project Review, November 1976 (hereinafter "DOI guidelines").

RESPONSE: The Department of the Interior (DOI) EIS preparation guidelines, Guidelines for the Preparation of Environmental Reports for Fossil Fuels, Steam Electric Generating Stations, are currently used as reference material in EPA's EIS preparation process. However, EPA is in no way required to use the DOI guidelines, either as reference material or as required preparation procedures. The DOI guidelines have proven quite helpful as reference material in our preparation process. Their orientation, however, is toward DOI areas of concern which results in a heavy emphasis of the biological aspects of a proposed action, an emphasis that would unbalance an EPA EIS. Subsequent references in the CARG comment letter are frequently based on EPA's transgression or unawareness of the DOI guidelines. This criticism is unfair in view of EPA's lack of requirement to adhere to the DOI guidelines.

COMMENT 4: EPA, like many other federal agencies, has requested from an applicant a technical report referred to as an Environmental Impact Assessment (EIA). Rather than using this document as part of its informational resources, EPA has, with some minor editing, reissued the EIA as its draft EIS. It is CARG's contention that EPA document number EPA-907/9-77-004, issued in August, 1977, is not an EIS required by NEPA, but only an EIA that the agency is circulating for comment. Former Region VII Administrator Jerome Svore, in a letter dated April 21, 1976 to Mr. D.H. McLeod, Production Manager for Iowa Southern Utilities (ISU) stated that the EIA would serve "both as ISU's Assessment and as the Environmental Protection Agency's (EPA) statement on the proposed permit action." This is in violation of both the letter and spirit of the law.

RESPONSE: CARG's assumption that EPA's draft EIS is, in reality, Iowa Southern Utilities' (ISU) Environmental Impact Assessment (EIS) is incorrect and consequently serves as an invalid basis for many of the subsequent comments by CARG about the EIS. At the point in project development when EPA assumed lead agency responsibility for development of the EIS, the project was ongoing. From this time, EPA pursued an active role in directing the development of the EIA/EIS in working with the applicant's consultant, Black & Veatch Consulting Engineers, in multiple revisions of the prepublished draft EIS. This participation and direction is well-documented in memos to the file, letters to Black & Veatch, meeting and trip reports on the part of both the consulting engineer and EPA. The development of an EIS concurrently with the development of an EIA has been a practiced procedure for a number of years, both within the Environmental Protection Agency and also within other Federal agencies (Reference: Corps of Engineers use of "third party" EIS preparation process). In particular, the San Francisco Regional Office of the EPA has practiced "piggyback" EIS preparation in regard to the proposed funding of wastewater treatment facilities mandated by Section 201 of the Federal Water Pollution Control Act as amended in 1972. Such practice has been tested in the judicial department and found acceptable.

COMMENT 5: Again it is clear that the EIA and the EIS are two distinct documents. The extent to which the two overlap depends upon whether requirements of items two and three above have been met and whether an EIS can be delegated to Iowa Southern Utilities. As to item two, there is no evidence that EPA assisted ISU in the preparation of the EIA as required by the CEQ guidelines. In a September 14, 1977 letter from McChord Carrico, Assistant General Counsel for ISU, to Dr. Kathleen Camin, Region VII Administrator, a chronology of events relating to the preparation of an EIS was outlined. According to Carrico, EPA first notified ISU by phone on January 5, 1976 that it would be the lead agency in the EIS review process for OGS. At that time EPA requested copies of the draft EIS (i.e., the EIA prepared for ISU by Black & Veatch which Carrico improperly referred to as the EIS). On February 6, 1976, six copies were delivered to EPA offices in Kansas City. Carrico letter, op. cit., p. 11.

RESPONSE: Again, CARG's comment that the EIA and the EIS are two distinct documents is based on the DOI guidelines, see response Number 4.

COMMENT 6: Has EPA independently evaluated the EIA? Again, there is nothing in the record to suggest that it has. The documents provided by EPA to CARG through the FOIS request previously cited, contain no reference to an independent evaluation by EPA of the data contained in the EIA. Nor is there evidence in the EIA itself which cites studies, interviews, or staff reviews of the EIA information. For example, section 4.0241, page IV-28 of the EIA states that "calculations show that even during summer conditions of high humidity and temperature, the pond water will have a temperature not greater than 5 F above ambient temperature." However, none of EPA's references cite an independent evaluation of these calculations to verify their accuracy. Similar instances exist throughout the entire document for such things as load forecasts, effluent discharges into the air, and economic impacts with and without the OGS.

RESPONSE: CARG's comment that EPA did not conduct an independent evaluation of, for example, the calculations referring to the humidity and temperature of the pond water in Section 4.0241 of the draft EIS, is based on the incorrect assumption that the EIS is in fact an EIA. EPA contends the document is in fact a draft EIS and as such is an EPA document, and therefore would not normally contain references which cite an independent (EPA) evaluation of these calculations to verify their accuracy.

COMMENT 7: The importance of independent evaluation cannot be underestimated. For example, on pages VI-21 and VI-23 of the EIA issued by EPA, a 161 kV line is shown to proceed west from OGS to the Monroe County border and then northward to Poweshiek County where it connects to an existing 161 kV line just south of Searsboro. However, in the notices sent to landowners in Poweshiek, Mahaska and Wapello Counties by ISU on Feburary 21, 1977, the most similar route was for a 345 kV line which was to proceed north from the OGS facility to Poweshiek County and then either west for about 2.3 miles before resuming a northern route or continuing due north, passing Montezuma on the west. Both the size and corridor locations are substantially different between the description provided by the EIA and that given in the February notice to affected landowners. This discrepancy was brought to EPA and ISU's attention by CARG in a September 22, 1977 letter to the two agencies. However, an independent evaluation by EPA would have uncovered this discrepancy in time to be corrected in the August 1977 EIA. Either EPA failed to conduct the independent evaluation which means that it is in violation of the CEQ guidelines and thus should not use the EIA as the draft EIS, or it did not cite the evaluations and reviews conducted and therefore is in violation of the "full disclosure" requirement of NEPA.

RESPONSE: The discrepancy both in regard to size and corridor locations of the 161 kV and 345 kV lines results from a change in routing by ISU between the time the Public Notices for such routings were publicized by ISU and the time of the publication of the draft EIS. Therefore, the routing error results from incongruous timing rather than a lack of independent evaluation by EPA for the proposed transmission routes.

COMMENT 8: EPA's regulatory function is an entirely different one than its function as a grant administrator for the construction of treatment works, a difference which must be recognized in its preparation of an EIS. CARG suggests, as the U.S. Court of Appeals for the District of Columbia urged the Federal Power Commission in Calvert Cliffs v. AEC, supra, that EPA review the procedures of the AEC, not the Nuclear Regulatory Commission. Those procedures also require the equivalent of an EIA from an applicant. However, a draft EIS is then prepared by the agency's staff and circulated for comment. In view of EPA's regulatory authority, a responsibility which requires greater discretion in its administrative decisionmaking, the OGS document circulated by EPA is improperly issued as an EIS. Even if EPA's decision to delegate the preparation of a draft EIS were upheld by the courts, the agency still fails to meet the criteria of guidance, participation and independent evaluation of the document prior to its approval and adoption as discussed previously in this section.

RESPONSE: CARG is correct in stating that EPA's regulatory function is different from its function as a grant administrator for the construction grants program. However, the law operative in this discussion is the National Environmental Policy Act and EPA regulations (40 CFR, Part 6) which prescribe the necessary procedures in the environmental evaluation.

COMMENT 9: Both ISU and EPA begin with the premise that a 727 megawatt electrical facility is necessary, a project-oriented assumption which becomes a self-serving assumption since a power plant of some type will be built. From there EPA and ISU justify the construction of a coal-fired facility since sufficient control technology is available to adequately reduce effluent discharge, economics and fuel availability favor the use of coal, and only a coal facility can be constructed in time to meet the expected demand by 1981 (this latter point is especially true since EPA has allowed ISU to begin construction of OGS before the completion of the EIS process, a fact which substantially prejudices the meaningful consideration of alternatives).

RESPONSE: The draft EIS does not begin with the premise that a 727 MW electrical facility is necessary but rather, at the outset, explores the need for additional power and bases the decision for future power need upon the officially accepted power demand forecast the Federal Power Commission-approved MARCA projections. In regard to CARG's comment concerning ongoing construction before completion of the NEPA process, EPA has not allowed ISU to carry on this activity. To allow such activity would imply that EPA had the power to prohibit it. As the EPA regulations and policy guidelines are now written, EPA has only advisory authority in this regard.

COMMENT 10: The objective of the Federal Water Pollution Control Act (FWPCA), as amended, is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." To achieve that objective, a national goal to eliminate the discharge of pollutants into navigable waters by 1985 has been established with an interim goal to be achieved by July 1, 1983 that would, wherever, attainable, provide "for the protection and propagation of fish, shellfish, and wildlife and [provide] for recreation in and on the water." PL 92-500, Section 101(a), et seq. Traditionally the achievement of these goals has been largely through the use of control technologies, those devices which filter and clean water used, for example, in the cooling of a power plant before it is discharged into a river or stream. However, the reduction in the use of cooling water in power plants through increased emphasis on energy efficiency can make, perhaps, a greater contribution to the restoration and maintenance of the biological integrity of our waterways since saving a BTU creates comparatively fewer pollutants to be filtered than does producing a BTU. Thus, conservation can have a very real impact upon water quality.

RESPONSE: Reductions in the use of cooling water in power plants through increased emphasis on energy efficiency is definitely desirable. However, this conservation method, as well as the other 13 conservation items listed in the CARG comment, can be implemented only from an advisory basis and cannot be forced upon the public under the present laws of the land. Energy conservation through cost incentives and various conservation-oriented pricing mechanisms probably is the most effective means of achieving energy conservation as listed by the 13 methods of CARG.

COMMENT 11: ISU relies heavily upon projections presented by the Mid-Continent Area Reliability Co-ordinating Agreement (MARCA) which were offered to the Federal Power Commission on April 1, 1976. Assuming that this data took a minimum of six months to compile into the MARCA Report cited by ISU, the data is now over two years old, an inadequate base of information upon which to approve a project which may cost more than two billion dollars throughout its lifetime. Since the collection of the information from utilities within the MARCA area, there have been substantial changes in both the National and State Policies which potentially can affect the demand forecasts. Nationally, Congress has enacted two significant pieces of legislation--the Energy Policy and Conservation Act (December 22, 1975) and the Energy Conservation and Production Act (August 14, 1976). Congress is also completing work on President Carter's energy legislation. All three of these measures signal a substantial change in our energy policies; each should be identified as to content and potential impact upon expected consumption patterns.

Within Iowa there have been significant changes in legislation which may substantially alter Iowa's consumption rates. Prior to the 1974 session of the Iowa General Assembly, no legislation had even been introduced with regard to energy conservation. Since that time over two dozen spearate bills have been filed. Among those measures adopted by the legislature three may have a substantial impact upon energy usage: a land use bill, an act providing the Iowa State Commerce Commission authority to evaluate future need of electrical power plants (note: OGS was exempted from the licensing provisions of the Commission bill), and finally, a bill authorizing minimum efficiency standards for buildings. Several other measures are pending. Each of these measures should be discussed, evaluating their collective and individual impacts upon Iowa's energy requirements.

RESPONSE: As previously mentioned, EPA accepts as official the Federal Power Commission-approved power demand projections as presented by the Mid-Continent Area Reliability Coordinating Agreement (MARCA). This projection is still considered official although the data may now be more than two years old.

RESPONSES

IOWA CITIZENS FOR ENVIRONMENTAL QUALITY

COMMENT 1: The OGS EIS as in the case of the George Neal EIS does not demonstrate the need for Power based on econometric analytical projections and a program of appropriate conservation options.

RESPONSE: We agree that demand forecasting based on econometric techniques is a reasonable estimate of power growth. We cannot agree that econometric modeling is the only reliable method for estimation of demand growth. The projections that were presented by the Technical Advisory Committee on Land Forecasting Methodology were approved by the Federal Power Commission and accepted by EPA as valid. Since any forecasting technique is largely a judgmental process, the accuracy of one method as opposed to another is difficult to determine.

COMMENT 2: No cost of Service Studies were presented to evaluate rate structures and possible restructuring to equalize costs thru the pricing mechanism and thus effect conservation practices. Additional options on pricing mechanisms i.e. "peak load" and "time of day" were not considered as conservation option.

RESPONSE: Conservation practices considered price structures as a method to reduce demand for power. Peak load pricing was discussed and has been implemented by Iowa Southern Utilities during the summer of 1976.

COMMENT 3: The entire subject of rates was carefully avoided. As a result the public or interested individuals can make no judgment or raise pertinent questions concerning the disparity or relative economic efficiencies between industrial, commercial and residential, rates. This is a serious omission since the existing practice of declining block rate structures which is wide spread in the industry is recognized as inequitable and economically inefficient in the allocation of scarce resources becoming scarcer.

RESPONSE: A section on user rates has been added to the final EIS (see Section 1.0221).

COMMENT 4: Perhaps the greatest single conservation program that can be initiated by the utility industry is one which is also prominent in the President's Energy Plan, that is cogeneration. The magnitude of this potential is evident in the statistics presented to the FEA by Thermo Electron Corp. (TE 5429-97-76) in May 1976. The decrease in industrial cogeneration from 15 per cent of all U.S. Energy use in the 1950's down to 4 per cent at the present time reflects the effective marketing program of the utility industry, in large part due to the declining block rate philosophy. This situation is characterized by subsidization of large (industrial) user by small (residential) users in many cases where cost of service studies have been carried out.

Reversal of this situation may be stimulated by the President's Energy Plan to provide tax incentives but accelleration of this conservation tactic can be stimulated by 1) adjusting industrial rates to reflect true costs and 2) a survey by the utility, and educational program, in its service area, of industrial customers ripe for a cogeneration program with 3), capital input or loans possibly from the utility itself on a pay back program similar to the proposed home insulation program. The Thermo Electron study demonstrated that cogeneration in key high energy use industries (cement plants, etc.) would require less than half the fossil fuel input of the electric generating station and could produce the needed energy at half the capital investment in a central power station.

RESPONSE: Cogeneration is the term applied to the practice of producing steam for both electric generation and other industrial processes or space heating use in a common steam boiler. In most cases, the steam for process or space heating use is required at pressures and temperatures above those of the reject temperature and pressure for steam used in electric generation. Thus, capacity must be planned and built into the boiler to provide steam at the proper temperature and pressure for the industrial use as well as to provide the necessary steam for turbine-generator operation at maximum load. It is possible to cooperatively plan electric generating and industrial process plants so that the resulting boiler efficiency is greater than that of the boiler used for electric generation alone. In order to accomplish this, the planning, construction, and operation processes for both the electric generating plant and the industrial plant must be in close proximity in both space and time.

In order to make use of the cogeneration concept for the Ottumwa Generating Station, it would be necessary to have an industrial user nearby to use the steam. Lacking such an industrial customer, it would be uneconomic to build excess steam capacity into the boiler to supply energy for a customer who may never exist.

COMMENT 5: The failure of the OGS EIS to address the conservation issue reflects a superficial and inadequate review of a very serious and urgent issue, one which is prominent in the National Energy Plan.

RESPONSE: Conservation of energy has been discussed (see Section 6.13). One must realize that conservation is a program that must be implemented primarily by the consumers of energy. Iowa Southern Utilities Company has undertaken an advertising campaign to educate the consumers on ways to conserve electricity, but the implementation of these conservation methods is still dependent on the consumers.

COMMENT 6: There does exist appropriate guidelines which can provide the EPA regional office with organized stepwise procedures in addressing the urgent but less established issues of market and demands for electric power.

The U.S. Department of Interior publication 14-31-001-5238, November 1976 provides one check list. A more important source is EPA's own Office of Federal Activities which is in the process of preparing guidelines for the preparation of environmental impact assessments on coal-fired power plants. Although this project is not complete the draft guidelines can be extremely valuable in addressing these issues mentioned above which have been omitted or inadequately treated in the OGS EIS.

RESPONSE: We are aware of these documents and use them as guidelines in preparing the EIS.

COMMENT 7: The principal environmental issue which we see unresolved in the OGS EIS is the question of air emissions and scrubber technology. The emissions which will have only particulate control with no gaseous removal system will allow all SO_2 to escape. Although the emissions may conform to 1.6 lb SO_2/million Btu, the conclusion is moot and based on inadequate chemical data. More importantly no cost/benefit analysis has been prepared to compare economic and environmental benefits from the best available control technology such as Venturi scrubbers as used in Colstrip units No.'s 1 and 2 by the Montana Power Company in Colstrip, Montana.

RESPONSE: Particulate emissions will be controlled by the use of a high efficiency electrostatic precipitator. Sulfur dioxide standards will be met through the utilization of low-sulfur western compliance coal as fuel. Nitrogen dioxide emissions will be controlled by design and operation of the boiler system. The air quality control system at the Ottumwa Generating Station will enable all air quality standards to be obtained.

COMMENT 8: Evaluation of impact required by NEPA not simply planning to meet existing air regulations. Some criticisms hold regarding vegetation damage as indicated in the George Neal comments from ICEO.

RESPONSE: All emissions and ambient concentrations of pollutants from OGS will meet federal and state standards. Since these standards were developed to establish safe, non-toxic concentrations of pollutants, no adverse effects on human health, other fauna or vegetation are expected.

COMMENT 9: Air concentrations at ground level are anadequately treated by the dispersion model (Appendix E). Frequency of high ground level concentrations which result from "fumigation," "down wash," "plume looping" and "trapping" is not considered. The EPA models for short term dispersion, if employed, have not been discussed in the report.

RESPONSE: The effects of unusual meteorological conditions were addressed in Section 2.03283 of the draft EIS. High average ground level concentrations over the time periods corresponding to the ambient standards are not expected as a result of these unusual conditions. The effects of "fumigation" were indicated to occur over very short time periods (generally less than 30 minutes). The frequency of stagnation conditions due to elevated inversions ("trapping") has been reported to be nearly zero over southeastern

Iowa. Hosler[1] has shown that less than 10 episodes have occured during a 25-year period.

Air flow over and around buildings and other obstructions is not expected to create aerodynamic downwash conditions because of the design chimney height. The chimney will be 600 feet above grade level. It is anticipated that this will be of sufficient height to avoid downwash effects.

The atmospheric condition typically associated with "plume looping" is extreme instability (Class A). Frequency distributions of winds and stability conditions for a 5-year period from Burlington, Iowa, show Class A conditions to be very infrequent. Class A conditions concurrent with wind directions within a 22.5 degree sector occur at most about six hours per year. Short periods of higher ground level concentrations could occur; however, applicable standards are not expected to be exceeded.

Atmospheric dispersion models developed by the EPA are not discussed in the draft EIS because they were not used for the air quality analyses. The model used has been developed by Black & Veatch Consulting Engineers and is based on recommendations of the American Society of Mechanical Engineers[2]. The model is generally conservative and considered to be appropriate for the present analysis.

COMMENT 10: Effects of terrain features on ground level concentrations should have been examined. The EPA model "TERRAIN" could have been employed.

RESPONSE: Computer runs were made using the EPA model "CRSTER" which enables us to consider the effects of topographic features on the atmospheric dispersion of pollutants. The resuts are shown in the following table.

COMMENT 11: The interaction of the cooling tower condensate plume and the stack plume were not considered in evaluating the formation of acid mists and its effects.

RESPONSE: Because of the difference in height between the cooling towers and the 600 foot tall stack, there will be negligible mixing of cooling tower vapor with stack gas to form small quantities of acid mist. Dispersion modeling of stack emissions show that ground level concentrations will be negligible.

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[1] C. R. Hosler, "Climatological Estimates of Diffusion Conditions in the United States," Nuclear Safety, 5(2), 184-192, Winter (1963-1964).

[2] American Society of Mechanical Engineers, Recommended Guide for the Prediction of the Dispersion of Airborne Effluents, New York, 1973, 85 pages.

ESTIMATED MAXIMUM GROUND LEVEL AIR POLLUTANT CONCENTRATIONS (SO_2) RESULTING FROM THE OPERATION OF OGS AT MAXIMUM CAPABILITY AND TAKING TOPOGRAPHIC FEATURES INTO CONSIDERATION

	Highest at Each Receptor	Second Highest at Each Receptor
Annual Mean Concentration	0.6	
Yearly Max. 24-hour Concentration	21.6	13.8
Yearly Max. 3-hour Concentration	173.1	77.3

COMMENT 12: The baseline evaluation program for air effects does not present data on the existing pollutant level in target species especially vegetation. Sulphur dioxide and fluorides both toxic to plants have not been analyzed in perennial vegetation within the most probable radii of high ground level concentrations. Neither has any consideration been given to establishing baseline levels for vegetation productivity to compare to post-operational impacts.

RESPONSE: Dispersion modeling of emissions from OGS have shown that all federal and state air quality standards will be met. Expected concentrations of sulfur dioxide and fluoride will be well below toxic levels for vegetation, and the analysis of vegetations for these substances is not indicated.

COMMENT 13: In considering the 1977 amendments to the Clear Air Act it is apparent that EPA is authorized to prohibit the use of western coal as a way in which utilities siting plants in other regions, could comply with implementation plans (see Environment Reporter Current Developments October 21, 1977 V8 #25 page 951). This option or requirement should be discussed. The entire relationship of the Ottumwa station's operation to the Iowa S.I.P. should be explained.

The technology proposed at the OGS also comes under severe review of the 1977 amendments as we are able to interpret them. We feel these considerations are major ones which require EPA's interpretation and explanation.

RESPONSE: Section 125(b) of the Clean Air Act as amended August 1977 enables the Governor, with the written consent of the President or his designee, the President's designee with the written consent of such Governor, or the President to prohibit any major stationary source from using fuels other than locally available coal or coal derivatives. This action can be taken only to prevent or minimize significant local or regional economic disruption or unemployment which may result from using nonlocal coal. The final cost to the consumer must be taken into account.

The Ottumwa Generation Station will be in compliance with the Iowa State Implementation Plan and its goals. The SIP is a plan for the implementation, maintenance and enforcement of a national ambient air quality standard (primary or secondary).

COMMENT 14:

(1) What now constitutes "significant deterioration" in Class II areas with respect to each pollutant.

(2) What constitutes best available control technology (BACT) under the new amendments. Will it be more stringent than NSPS?

(3) Under the new amendments BACT reviews will include photochemical oxidants, nitrogen oxide and lead. How will this be handled in the EIS process on OGS?

(4) New requirements apply to sources which commenced construction on or after August 7, 1977. We assume officially that OGS has not commenced construction since this is the period NEPA review, true?

In conclusion we feel that the issues surrounding the Clean Air Amendments combined with paucity of data on demands and marketing of power plus the notable lack of conservation alternatives is sufficient evidence for a reissue or supplemental Draft EIS and request that EPA consider this action.

RESPONSE:

(1) Section 163(b)(2) defines the maximum allowable increase in concentrations of SO_2 and particulates. To exceed these increases is significant deterioration.

For any Class II area, the maximum allowable increase in concentrations of sulfur dioxide and particulate matter over the baseline concentration of such pollutants shall not exceed the following amounts:

Pollutant	Max. Allowable Increase (micrograms per cubic meter)
Particulate matter:	
Annual geometric mean	19
Twenty-four-hour maximum	37
Sulfur Dioxide:	
Annual arithmetic mean	20
Twenty-four-hour maximum	91
Three-hour maximum	512

(2) Best available control technology (BACT) means an emission limitation based on the maximum degree of reduction of each criteria pollutant which the permitting authority has determined is achievable for a specific facility. This determination is made on a case-by-case basis and taken into account energy, environmental, and economic impacts and other costs. This limitation must not exceed New Source Performance Standards (NSPS). The Agency's interpretation is that BACT is the technology necessary to achieve NSPS in regard to OGS.

(3) During the PSD review, the abatement equipment is evaluated based on the degree of reduction of each pollutant. When reviewing a coal-fired power plant, three criteria pollutants are analyzed; SO_2, NO_x, and particulates. Photochemical oxidants are not emitted from a coal-fired power plant, control of photochemical smog is achieved by limiting NO_x emissions. At present, there are no standards for lead, but we are anticipating the promulgation of these standards in the near future.

(4) According to Title 40 CFR 52.27(b)(7) "Commenced" means that an owner or operator has undertaken a continuous program of construction or modification or that an owner or operator has entered into a contractual obligation to undertake and complete, within a reasonable time, a continuous program of construction or modification. Prevention of Significant Deterioration (PSD) of air quality approvals are exempt from the National Environmental Policy Act and, therefore, PSD approvals can be granted at any time during the environmental review. According to the Clean Air Act as amended in 1974, Iowa Southern Utilities commenced construction in 1975 and obtained the PSD approval in 1976.

COMMENT 15: In conclusion we feel that the issues surrounding the Clean Air Amendments combined with paucity of data on demands and marketing of power plus the notable lack of conservation alternatives is sufficient evidence for a reissue or supplemental Draft EIS and request that EPA consider this action.

RESPONSE: EPA will issue a final EIS on the Ottumwa Generating Station since the changes made in the draft EIS do not warrant a supplemental draft EIS at this time.

COMMENT 16: Under Sec. 102(c)(iii) of NEPA, the alternatives to the proposed project have not been adequately explored. This fact is emphasized in the description entitled, "Need for Power" starting on page I-9. Documentation for need does not appear in MARCA projections. Such documentation, to be valid, requires the support of econometric projection based on price/demand techniques of analysis which are well established. In general, electric utility marketing programs until recently have ignored these scientific techniques for projecting power demand, with the result that the mushrooming cost of power production has generated spiralling rate increases. These rapid sequences of rate hikes have resulted in decreasing electricity usage, consequent idle generating capacity and dramatic loss of investor confidence in the utility industry. Overcapacity and decreased earning in 1974 and 1975 led to a crisis. According to Bankers Trust Company of New York, "Probably no industry has come closer to the edge of financial disaster."

This dilemma within the industry has been the result of casual and inadequate demand projections based on historical extrapolations in a market that has changed dramatically. Since 1970 when the cost of electricity production stopped its downward trend, considerable increases in production costs due to rapid rises in the cost of installed kilowatt capacity combined with decreasing availability factors of newer large units, have harnessed utility customers with a legacy of debt for idle generating capacity. The present situation calls for a new pricing philosophy based on equitable and sound economic techniques of analysis. Applications of these techniques are nowhere in evidence in this Draft EIS of the Neal Generating Station. Basically, two major considerations need to be addressed.

(1) Failure of historical pricing mechanisms to relay to the consumer through price signals the costs of his service on the basis of time and quantity of demand.

(2) The failure to apply appropriate and established econometric techniques of price/demand analysis to project future demand, so critical to estimation of capacity needs.

REPONSE: See response to Iowa Citizens for Environmental Quality 1.

COMMENT 17: Correction of the flaws in pricing mechanisms are being undertaken by many utilities, principally through orders from their state utility commissions (Wisconsin, Missouri, Vermont, New York, Michigan, Florida, etc.). These corrective actions are reflected in efforts to initiate marginal cost pricing and time of day pricing which in combination can convey accurate price signals and improve load balancing over short, intermediate and long run periods. To list these specific cases and techniques requires considerable space, but the options are well described in recent orders of the Wisconsin Public Service Commission and in the recorded testimony of Iowa Commerce Commission hearings of December 7, 1976. Excellent detailed testimony by recognized rate economists are readily available (Charles J. Cicchetti in Pacific Gas & Electric Company application #54279 before the California Public Utilities Commission and in Madison Gas & Electric Company Docket #2-U-7423 of the Wisconsin Public Service Commission; also Fred J. Wells in Docket #U-1933 before the Arizona Commission on behalf of Tucson Public Power). A brief report by J. Robert Malko, Chief Economist of the Wisconsin Public Service Commission (Public Utilities Fortnightly, July 15, 1976) is attached which describes the philosophy and feasibility of marginal cost pricing and time of use pricing now being initiated in Wisconsin.

RESPONSE: Rate structures are set by the utility companies at present and EPA has no regulatory authority over them. Pending ratification, the Energy Plan will allow the state to regulate rate structures. This should lead to a more equitable rate structure than the declining block structure.

COMMENT 18: Efficient load management cannot be achieved without accurate cost of service information and the fair allocation of thoses costs to the users creating the demand. The present declining block rate structure in general practice does just the opposite, it rewards the consumers creating peak demand through subsidies paid by off-peak users. Such rate structures did not appear inequitable when the cost and price of electricity were declining due to economics of scale and other efficiencies. Since 1970, however, the increasing costs of power have only emphasized the social inequities and economic fallacy of declining block rates.

RESPONSE: See response to Iowa Citizens for Environmental Quality 17.

COMMENT 19: Perhaps the most serious omission in the Neal EIS is the absence of justification supported by valid data which would lend credence to growth projections claimed. In particular, the three utilities (Iowa

Public Service Company, Interstate Power Company and Northwest Iowa Power Cooperative) claiming the lion's share of the George Neal IV output disclose no information on cost of service or load analysis to support the need for the new station. Specific data are also lacking on the capital cost of George Neal IV, its anticipated capability factor and its impact on retail prices of electricity in the residential and industrial service sectors.

Such data voids cannot be explained away by claiming lack of information. In particular, the methods of forecasting demand based on the accepted procedures using economic models is by now a well-organized technique in the industry. A study published in 1975 by the Federal Power Commission demonstrated that the projections of power consumption by the National Electric Reliability Councils for 1980 were about 40 per cent too high when econometric demand analysis techniques were applied to each NERC. In particular, MARCA projections were 49 per cent too high. A copy of the report, "Electricity Demand: Project Independence and the Clean Air Act," ORNL-NSF-EP-89 is attached. Overforecasting demand is a serious economic flaw, especially since debt retirement of today's new facilities accounts for roughly 75 to 80 per cent of the average bill.

Exhibit A is a list of references describing applications and results of demand forecasting. We urge that these techniques be considered in developing an economically and socially acceptable procedure that can more accurately assess the need for George Neal IV.

RESPONSE: See response to Iowa Citizens for Environmental Quality 1.

COMMENT 20: The Neal Draft EIS does not adequately report upon nor discuss the data used as the basis for projecting demand in the MARCA and MAPP region as indicated in the EIS.

We anticipate that, to a large extent, the data necessary to accurate demand forecasting is in the files of the utilities but additional data may be required to apply the appropriate forecasting technique referred to in out Exhibit A. The data needed for this type of analysis is well expressed in the statement (Exhibit B) by Mr. Robert O. Marritz, executive director of the Missouri Basin Systems Group and in Exhibit C by Mr. Roy B. Hurlbut, utility specialist and energy adviser. These two exhibits are taken from testimony presented to the Iowa Commerce Commission at its hearing on December 7, 1976. We urge that the data needs described in these two statements be obtained and a re-evaluation of need for George Neal IV be made on the basis of professional econometric analysis. NEPA is very clear in emphasizing that all agencies "Utilize a systematic, interdisciplinary approach... in decision making."(102A) CEQ Guidelines (38 Fed Reg 20550-20562, 1973) express the responsibilities of Federal agencies to develop a "rigorous exploration and objective evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential." 1500.8(4). It is apparent that in the failure to treat the issues of demand forecasting and the application of marginal cost pricing and time of use pricing, viable alternatives, which might result in postponing or cancelling this economically and environmentally costly generating capacity, were precluded from consideration. We urge this omission be rectified in a supplemental draft EIS.

RESPONSE: See response to Iowa Citizens for Environmental Quality 1.

COMMENT 21: The role of energy conservation has been ignored in the Neal EIS. Options to save energy in electric power consumption are many and varied. The environmental and health costs of fossil fuel combustion are well documented in EPA and CEQ publications. The political implications of energy saving have been emphasized in Project Independence reports and Federal Energy Administration literature. The economic burden in higher utility bills to consumers caused by the new George Neal IV station are not analyzed in relation to the potential savings to be gained from conservation techniques. It is obvious that any program of conservation requires some investment. What is needed in this cases is a Cost/Benefit analysis of alternatives which in fact are called for under CEQ guidelines.

Conservation measures should be considered in two general ways; greater efficiencies at the same level of consumption, and modifications of technology and/or practice which decrease total energy consumption.

The first approach can be achieved through load balancing and full substitution. Load balancing had been effectively demonstrated in peak load pricing techniques in Vermont and is now underway in Wisconsin and planned by several other states. Pennsylvania Electric Company simply through a publicity campaign aimed at reducing residential peaks, realized a 22 per cent improvement with a $700,000 saving. Fuel substitution using the more efficient fossil fuels for hot water and space heating as opposed to electric is capable of reducing peaks as well as total use.

Information on applicance efficiency is a valuable help in consumer selection of high wattage units. Air conditioners are a prime target since they create the summer peaks in midwest residential demand. A study of a Missouri service area showed that replacing all air conditioners of low efficiency with the most efficient models available would be a cheaper option than building the power plant required to meet the rising demand created by the old air conditioner peak.

Such options for conservation should be analyzed on a cost/benefit basis of kW of demand saved vs newly installed generation capacity. The response of industrial customers in Iowa to load management programs is proved by the successful test run by IPALCO to reduce load of 15 large consumers in the summer of 1975. The projected periods of high demand were relayed to the customers who were given credit for reducing their demand. Peak power was reduced to 3,521 kW at a cost of $10,563 in credits. Contrast this to an installed cost of $800/kW which would require a capital investment of 2.8 million dollars. In summary, we urge that conservation alternatives be initiated and developed under guidelines of the Energy Conservation Act of 1976 and the assistance of other Federal, state and private parties as directed under NEPA and CEQ Guidelines. The alternative of "Not Providing Power," p. VI of the EIS, is a wholly inadequate statement in addressing the alternatives contained in paragraph 102(c)2(iii) of NEPA.

RESPONSE: This comment is addressed to the George Neal IV Station and appears to be inappropriate for the Ottumwa Generating Station.

In the Draft EIS for Ottumwa Station, alternatives to reduce demand were discussed in Section 6.13 on page VI-36.

COMMENT 22: In estimating air emissions, first order consideration is coal composition. In the EIS, p. II-3, the presently operating Neal Units 1-3 are described as using Hanna Wyoming coal with an average sulfur content of 0.6 per cent. This coal created an emission rate of 1.3 lb/mB which is permissible for old sources but would not be for new sources. Over on page IV-56 an inconsistency appears when the typical S content is said to be 0.32 per cent. This, we presume, is the same Wyoming coal source. Such casual use of analytical data is unacceptable for several reasons.

(1) Sufficient replicates of coal should be analyzed to provide a variance and confidence level of analysis.

(2) Coal should be sampled in the prescribed manner throughout the seam and throughout the seam face in order to provide a measure of the variance of the chemical constituents due to the naturally occurring compositional differences. Adequate chemical data have been reported on Western coals to demonstrate large naturally occurring chemical variances within a seam on both vertical and horizontal axes. In the case of sulfur, this variance can be threefold. It is therefore possible for George Neal IV to exceed Federal emission standards for extended periods when higher sulfur areas are encountered. Unless more definitive evidence is presented to assure compliance, we urge scrubber be installed.

RESPONSE: The comments concerning coal for Neal Units 1 through 3 are not appropriate for Ottumwa Generating Station.

COMMENT 23: The emission of minor constituents released either as a gas or particle has not been treated adequately. The toxicity of many of these elements is well known, e.g., the heavy metals Pb, Cd, As, Se, Hg, etc., and the lighter elements Be and F. The mass balance of these elements through the plant should be considered in detail. There is a sequestration process taking place in all coal-fired plants. Some elements are found enriched in bottom ash while some are enriched in stack gases and fly ash. The trend for many toxic elements to become enriched in the small particulate size (.1 to 1 micron) of fly ash poses respiratory threats since they reach the lung alveoli. Even though these particulate releases may meet emission standards, they add to air shed loads since they are capable of being transported large distances. These incremental pollutant loads added to urban air sheds should be discussed in relationship to the findings of EPA's CHESS report. Such factors also should be considered on a Cost/Benefit basis.

RESPONSE: A discussion of trace elements expected in gaseous emissions and fly ash is given beginning in paragraph 4.0225 on page IV-18.

COMMENT 24: Of these minor elements, fluorine poses a very great threat to vegetation. It is 100 to 1,000 times as toxic as sulfur dioxide and the sulfur/fluorine ratio in Western coal makes fluorine a greater threat to sensitive native and agricultural plant species than sulfur. The phytotoxic effects of fluorine were discussed by Gordon et al. at the American Chemical Society Symposium on Fluorine Compounds in the Environment, 8/31/76 at San Francisco, California. We urge that direct data on fluorine concentrations in the air and environment of George Neal Units 1-3 be determined. The environmental sampling program reported by Gordon in Montana showed fluorine accumulation and significant pathology to native vegetation in the vicinity of a 180 MW power plant burning Rosebud seam coal, a "typical" Western low sulfur coal. The impact of 1,573 MW of George Neal 1-4, by comparison, approaches an order of magnitude greater than threat.

RESPONSE: The comments concerning fluorine are addressed to George Neal 1-4, and therefore are difficult to relate to the Ottumwa Generation Station.

The maximum concentrations of fluoride expected from OGS emissions are given in Table 4-9 on page IV-23 of the Draft EIS. As shown, the predicted levels are far below the limits of human exposure. The concentrations reported as toxic to native Montana vegetation by Gordon are well above the concentrations shown in Table 4-9.

COMMENT 25: This section, which deals with potential impacts of very significant economic importance, is deficient in addressing the known scientific facts about sulfur dioxide pollution. It also attempts in the opening paragraph to place this serious plant toxin in a favorable light by suggesting a minor and debatable benefit. Indeed, the fact that leaf stomata take up SO_2 is the principal explanation for the first step in the toxicity chain of events.

RESPONSE: This comment is not applicable to the Draft EIS for Ottumwa Generation Station. It appears that the comment was directed toward another document.

COMMENT 26: The conclusion on page IV-63, "it appears unlikely that the predictable maximum annual concentrations from George Neal Units 1-4 will injure flora of the site and surrounding region" is made in the face of scientific evidence to the contrary. Much is made of the data projected from diffusion modelling which would support the hypothesis that emissions from all four units will meet ambient and emission regulations. In the first place, we believe that these projections are inadequate substitution for sufficient field observations which should have been underway at sites 1-3 and carried out in a more purposeful scientific design. Even dismissing this criticism, however, the facts under consideration in the NEPA process are not simply compliance with regulations, but the estimation of any impact this project will produce irrespective of regulations. The following observations amplify the impacts of sulfur dioxide and emphasize the omissions of these important data in the draft EIS.

(1) The senstivity of economically important crops in this area, corn and beans, has been demonstrated in controlled experiments at SO_2 levels well below even secondary standards. In 1966 through 1967, the National Air Pollution Control Administration carried out greenhouse studies in Kansas City on sensitive plant species including corn and beans. The experimental plots were grown in an atmosphere whose SO_2 levels during the growing season were below Federal ambient standards. Nevertheless, plant growth was suppressed 25 to 50 per cent compared with controls.

RESPONSE: This comment is for George Neal Units 1 through 4. Sulfur dioxide emissions from the one unit at OGS will meet all federal and state standards and will be below reported toxic levels for plants.

Please refer to response to comment 44, Iowa State University, for a discussion of impacts on vegetation of pollutants from the Ottumwa Generating Station.

COMMENT 27: Serious fumigation episodes at Mount Storm, West Virginia, in 1972 and Kyger Creek, West Virginia, in 1973 caused extreme foliar damage. In July of 1971 and twice during 1974, the plume of the TVA 1,750 MW Shawnee plant fumigated at acute levels affecting 26,400 acres of soybeans in 1971 and 41,800 of vegetation in 1974. EPA representatives made field observations during these episodes and a full description including the potential for similar impacts at the George Neal site should be presented. In addition, the comments of Dr. Clarence C. Gordon, Plant Pathologist, University of Montana, Missoula, who investigated and reported on these episodes, should be sought.

RESPONSE: This comment is for the George Neal Station.

Concerning OGS, the air quality control systems will control the concentrations of pollutants below all federal and state standards. Unit evidence is provided that these standards are not adequate to protect the environment and are changed, then it must be concluded that concentrations of pollutants that are in compliance are not harmful.

COMMENTS 28: The National Environmental Research Laboratory of EPA has been conducting Zonal Air Pollution research with SO_2 at their Montana study site. Results of these studies should be obtained and the data, where possible, used in evaluating vegetative impacts at the George Neal site.

RESPONSE: The data available from the National Environmental Research Laboratory study conducted at Colstrip, Montana generally are of a baseline nature and are not suitable for predictive purposes.

COMMENT 29: The section on acid rain (EIS, p. IV-67) is a vague and incomplete description of the scientific knowledge and true impacts of acid rain. Since 1952, European investigators have carried out precipitation chemistry studies throughout western Europe. These studies, which are reported in over 100 scientific articles, demonstrate rather vividly that acid rain primarily caused by atmospheric emissions of the industries of Germany, France, and England have caused in the past and are currently causing a serious impact upon the aquatic and terrestrial ecosystems of Norway and Sweden. A condensed version of what is currently known about acid precipitation and its effect on ecosystems can be found in a 1976 USDA 1,074-page publication (Technical Report NE-23), "Proceedings of the First International Symposium on Acid Precipitation and the Forest Ecosystem." It is imperative that the EIS writers obtain this publication and attempt to relate the known data to the potential SO_2 and NO_2 emissions to be released from stacks of George Neal Units 1 through 4. In amplifying further the specific impacts on plants of acid rain, we suggest the report of Gordon in "Proceedings of Fort Union Coal Field Symposium 4/25-26/75" at Eastern Montana College, Billings, be reviewed. Also important is Gordon's testimony before the Montana Energy Siting Board in 1974-75. The need for a rainwater monitoring program to determine the acid rain potential of the currently operating George Neal Units 1 through 3 is essential. It should have been intiated at least by the Spring of 1976 when NEPA procedures began to be applied. The entire on-site monitoring program for providing needed data on the phytotoxic pollutants is inadequate. We urge that steps be taken to design a program that will provide sufficient data to establish a benefit/cost analysis on potential economic impacts to agricultural crops resulting from the George Neal complex.

RESPONSE: This comment is for George Neal Station.

Please see response to comment number 4.

COMMENT 30: The effects of air pollutants on higher animals starting on page IV-69 of the draft EIS omits impacts on man. Perhaps the reasoning here is that the primary ambient air regulations of the Clean Air Act cover adequately such impacts. In our interpretation of NEPQ, such is not the case. CEQ guidelines emphasize the importance of detailed considerations of all impacts. In the case of the George Neal plume, the annual loads of pollutants released are huge and may increase. The ultimate fate of these pollutants, SO_2, F, NO_x particulates with toxic trace elements, have to be evaluated carefully and their potential effects discussed. These pollutants in part are deposited locally, yet the bulk of all are transported considerable distances off site. They may be ultimately precipitated by wet and dry deposition processes, arriving at target sites which may be highly sensitive or refractory. At any rate, they contribute to pollutant loads in adjoining air sheds and such incremental threats to human health, biota, and materials are not insignificant by any means. These effects should be evaluated. The atmospheric modelling and Benefit/Cost analysis technique of EPA are capable of providing such information. Such concepts are already incorporated into the non point source philosophy. Through these and the previously cited considerations, the provision of NEPA can receive the substantive response it demands and the ultimate best alternative rationally adopted.

RESPONSE: This comment concerns George Neal Station.

Standards for sulfur dioxide, nitrogen dioxide, and particulates will be met at the Ottumwa Generation Station. No adverse impacts on human health are expected to occur from these pollutants.

As shown in Table 4-9 on page IV-23 of the Draft EIS for Ottumwa Station, predicted concentrations of trace elements will be well below the limits of human exposure.

RESPONSES

WAPELLO COUNTY CONSERVATION BOARD

COMMENT 1: No mention is made of the pollutants that will be mixed with the rainfall runoff from the coal storage area nor does there appear to be any plans for treatment of this water. Instead these waters are to be discharged into the Des Moines River via an underground siphon. There is no suggestion of a study to determine the effects these pollutants will have on the aquatic ecosystem of the area or the terrestrial inhabitants. Nor is there any mention of the effects of such pollutants on the water purification system of the city of Ottumwa.

RESPONSE: Please refer to response to Iowa State University comment number 33.

COMMENT 2: Paragraph, 1.048 Fuel Supply, Transportation, and Utilization.

We find it very disquieting to find that no contracts have been signed to assure the use of low sulfur Wyoming coal. At a public hearing held on this EIS, officials of Iowa Southern Utilities, assured us that Wyoming coal would be used however we see no concrete evidence of this in the EIS which leaves the door open to a change in fuels, i.e., high sulfur coal.

RESPONSE: A contract has been signed with Sunoco Energy Development Company to supply low sulfur coal from the Powder River Basin in Wyoming. This coal will be utilized as fuel for the Ottumwa Generating Station.

COMMENT 3: Paragraph, 1.0483.

What effect to the air quality will dust from the coal crushing activity have? Furthermore, what effect will this dust have on the water quality of the Des Moines River, the surrounding plant life, and the workers involved in this activity?

RESPONSE: The coal handling system at OGS will be equipped with dust control equipment at all transfer points and at the crusher house. High efficiency baghouse filter units will collect virtually all the coal dust generated and there will be no adverse impacts on the surrounding environment or hazards to human health.

COMMENT 4: Section IV Environmental Impacts of Plant Construction
Paragraph, 4.0111 General

"Were this a natural, or near natural area, these impacts would be severe indeed, and difficult to justify. However, the impact of the plant relative to the degree of environmental disruption already present on the site reduces the severity of the impact of the facility."...

We find this statement to be, at best, arrogant. We feel it would be hard to achieve a more severe impact on the area and its inhabitants than to completely destroy the surrounding habitat.

It appears that the author of the statement has neglected the benefits to wildlife, the people of the area, state, and world, of the agricultural practices of the area, such as food shelter and concealment. These benefits are not short-termed either, the problems of world hunger will exist far beyond the thirty year life of the OGS and the loss of 790 acres of crop land is far more critical to this problem than is the construction of this facility.

RESPONSE: As pointed out by Iowa State University scientists, most of the natural habitat on the OGS has long since been destroyed or severely altered by agricultural acitivities. The conversion of the site from agricultural to industrial use will have less environment impact than if the conversion was from a natural state to industrial use.

In 1975, about 301 acres were planted in corn, 147 acres in soybeans, 88 acres were in hay and 259 acres in pasture (paragraph 2.0731) on page II-96). The total loss of this production would be a very small percentage of the total agricultural production capacity of the region. The loss of this land for agricultural purposes must be weighted against the benefits to be derived from the production of needed electric power.

It also should be noted that after construction of the facility is completed, portions of the site will be leased for agricultural purpose.

COMMENT 5: Paragraph 4.0112 Impacts on Vegetation

According to this section there will be a loss of only five acres of vegetation. No mention is made of the remaining 790 acres of crop land or the far reaching effect of its loss. We refer you to the preceding comments made on this subject and ask if we can afford the permanent loss of this much land? We would also refer you back to page two of the glossary in this EIS and the definitions of "ecosystem" and "environment," of which these lands are a part.

RESPONSE: Please refer to response to comment number 4.

COMMENT 6: Section VII Relationships Between Short-Term Uses of Man's Environment and Maintenance and Enhancement of Long-Term Productivity.

This title is long, precise, and involved, and would lead the unexpecting reader to expect a lengthy and detailed discussion of the subject. Unfortunately this is not the case, instead the reader is presented a short, shallow discussion having no correlation to the title or subject matter whatsoever.

The major problem with the short-term benefits is that they are short-term. What is to become of the facility after its useful life of thirty years is realized? There is no discussion of the inevitable obsolescence of this plant and what or how its closing will effect the area sociologically, economically, and/or environmentally. Is it to be left to rot and rust creating an eyesore on the landscape when its usefulness is out lived?

RESPONSE: Short-term and long-term relationships are required considerations for an Environmental Impact Statement.

Following the useful life of Ottumwa Station, the site likely will continue to be utilized for some type of industrial activity. It is possible, however, that the area could be converted to agricultural uses. Exactly how the facility and site will be used after 30 years is unknown.

COMMENT 7: In paragraph 7.01 the life of the OGS is termed "...short-term..." yet in paragraph 7.022 it is sited as, "...an increase in human productivity stimulated by the availablity of additional electric power."..., a significant long-term effect. Which are we to believe, when does short-term become long-term; apparently when it serves the needs of the owners of the OGS.

RESPONSE: "Short-term use" is defined as "the 30 year expected life of the generating station" (paragraph 7.01 on page VII-1).

"Long-term use" is defined as "the resource development potential which remains after the life span of the generating station," (paragraph 7.02 on page VII-1).

Increased human productivity stimulated by the availability of electric power would hopefully extend beyond the life of OGS.

COMMENT 8: Examination of the data contained in tables C-1 and C-2 will show that some species will be affected, minimally; moderately, local population depression; moderately detrimental; or "present status or no apparent impact." The first question that comes to mind is, what do these terms mean? Next by what standards were these definitions assigned?

Further examination will show that 18 per cent of the terrestrial species occurring in the site area will be effected by a "moderate, local population depression," and that 86 per cent of the avian species occurring in the site area will experience a "moderately detrimental" effect caused by the OGS.

When one combines these data they will find that 78.6 per cent of the combined species will suffer a "moderate, local population depression/moderately detrimental" effect from the OGS, a figure which we find to be alarming.

RESPONSE: The effects of the impact of the project on various species of animals are the professional opinions of scientists from Iowa State University who studied the site. It is likely that 78.6 per cent of the combined species associated with the site will be adversely affected to some extent by the project. Since there is only a small amount of natural habitat remaining and most of the land has been used for agricultural purposes, the number of animals potentially present is very limited. The actual number of species involved, therefore, probably would be small. It also is likely that some species would simply move to adjacent habitat areas and continue to exist.

RESPONSES

JEAN DIMMITT SEDAR

COMMENT 1: In my opinion, it is poor judgement to condemn excellent farm land for the construction of the transmission line when alternate routes exist in land which is not under cultivation. Utilization of Des Moines River land or the railroad right of way would be more feasible.

RESPONSE: See response to Iowa State University comment 28.

COMMENT 2: Since no one really knows the precise and/or long-term effects of magnetic fields induced by high voltage lines upon human or animal life, it goes without saying that such lines should not run through inhabited areas if at all possible.

RESPONSE: In November 1974, the New York State Public Service Commission (PSC) ordered that a comprehensive evaluation be made of the health and safety questions concerning the construction and operation of proposed 765 kV transmission lines in upstate New York (1). The issues included audible noise, ozone, electric and magnetic field effects.

During hearings, testimony was given by 26 expert witnesses, and over 10,000 pages of hearing records were amassed. After 20 months of investigation, the Commission permitted the construction of the 765 kV transmission line. The ruling was the majority opinion of the Commission, one of the five members being in dissent.

The Soviets previously (1972) reported that power frequency electric fields may cause undesirable effects in exposed workers (2). The studies dealt with effects on workers in 500 kV and 750 kV switchyards. This very controversial work reported headaches and general malaise and attributed these to electric fields in the switchyard.

Similar studies conducted at Johns Hopkins University were in direct opposition to the Russian study (3). According to a Johns Hopkins' scientist, the study "found zero effects--absolutely zero."

The results of the Russian study also could not be confirmed from examinations of similar workers in Canada, England, West Germany, and Italy (4).

No experiment thus far has clearly established that electric fields, even 20 times as high as those encounted under 765 kV transmission lines, can cause a biological effect of significance (4).

All of the transmission lines proposed for the OGS system are voltages and designs which have been used throughout the United States for several years and are well below 765 kV. The highest voltage planned is 345 kV.

COMMENT 3: Farm operations are hampered; operation of large farm equipment is very difficult around the pylons supporting the transmission lines. Aerial spraying and dusting operations would be impossible.

RESPONSE: See response to Iowa State University comment 28.

COMMENT 4: The easement for a 100 foot strip of land across the property lessens the desirability of the farm and diminishes its value.

RESPONSE: There has been much discussion concerning the value of a particular property before and after a transmission line has been constructed on the property. The Doane Agricultural Service* has determined that there are but very few cases where there is any perceptible or acknowledged loss in value of the property directly attributable to the fact that a power line crossed the property.

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*A company with offices throughout the United States that performs farm management, consultation, appraisal, and market research in the field of agriculture. Headquarters for Doane Agricultural Service are located at St. Louis, Missouri.

REFERENCES

1. State of New York, Public Service Commission, Cases 26529 and 26559--Common Record Hearings on Health and Safety of 765 kV Transmission Lines, November 24, 1976.
2. Korobkova, V. P., Yu. A. Morozov, M. D. Stolarov, and Uy. A. Yakub, "Influence of the Electric Field in 500 and 750 kV Switchyards on Maintenance Staff and Means for Its Protection," CIGRE Report No. 23-06, 1972.
3. Shah, K. R., "EHV and the Environment: An Engineering Guide," Electric Light and Power, T/D Edition, August 1974.
4. Kornberg, H. A., "Concern Overhead," EPRI Journal, No. 5, June/July 1977.

RESPONSES

JAMES P. RIELLY

COMMENT 1: It is the position of our organization that permits should not be granted by the Federal Government with regard to this plant for the reason that there has been no need demonstrated for the construction of another generating facility in this area. At the present time the Congress is working on the Energy Policy which will be developed for many years to come. We think it is premature to grant and authorize a permit which will affect our environment with regard to this generating plant until such time as we are aware of what the future Energy Policy of this country will be. It may well be it is not necessary to construct this plant, which will have an adverse effect upon our environment if the policy shows that the energy needs are not that great.

RESPONSE: See response to Iowa Citizens for Environmental Quality comment number 1. Predictions indicate the need for the generating station.

COMMENT 2: With regard to the effect of the transmission lines on agricultural real estate, we believe that the proposed draft environmental statement which was circulated and which was discussed at the meeting of September 28, 1977, it is highly misleading in that in paragraph 6.08218 it is stated "intensively cultivated areas will be avoided." This statement is absolutely false! On the plat which appears on the opposite side of the page from that quotation, being plat VI-21, there is shown a proposed transmission line on which Iowa Southern Utilities Company has had hearings before the Iowa Commerce Commission and which they have obtained the right of eminent domain. It is submitted that this transmission line goes directly through some of the finest agricultural land in the world. To substantiate this position we would call to your attention the fact that there are approximately nineteen court cases pending in Mahaska County District Court and the Mahaska County Court House is located in Oskaloosa, Iowa. A review of these cases will show that the condemnation jury which is composed of real estate persons who are knowledgeable and who are experts in the area of valuation have awarded agricultural property owners and their tenants substantial damages for the condemnation of their land to put the transmission lines through Mahaska County. All of these awards which are substantial have been appealed to Mahaska County District Court by the Iowa Southern Utilities Company, who does not want to pay the amounts that the condemnation jury awarded in their deliberations. This is why these cases are now pending in Mahaska County District Court. A review of these awards will show that one Jacquelyn R. Mick was awarded $4,500; Pierson Seed Producers $6,500; Homer Hasselman $5,000; Cliffton Smith and his son Marvin Smith were awarded a total of $12,500; Lawrence Everett and his brother, Frederick Everett were awarded a total of $19,000; Marion Franje was awarded $42,000; Irene Weber was awarded $15,000; Howard LaRue was awarded $8,200; and Merle Van Steenis was awarded $14,000. These figures are very dramatic and show without question that Iowa Southern Utilities Company is causing a great deal of damage to intensely cultivated areas and the experts who were on the condemnation commission recognized the extent of these damages. It is respectfully submitted that these figures are the best of evidence to show that there is a devastating impact on prime agricultural land in Mahaska County because of the proposed construction of the transmission lines of this plant.

RESPONSE: See Iowa State University comment numbers 28 and 29.

COMMENT 3: It is further submitted that with regard to the informational hearings that were held at William Penn College in February 1977 with regard to another proposed route which would run to the east of the route shown in the Environmental Impact Statement, that that proposed route would be even more devastating to prime agricultural land than that which has already been condemned through the proceedings before the Iowa Commerce Commission. Some of the persons that would be affected by that proposed route would be endangered by having a high voltage line very close to important improvements which would endanger the lives of the persons living in the area. We have had in this area a number of very serious personal injuries as a result of high voltage line wires where contact has been made with grain elevators and that type of equipment as well as a number of deaths. It is the concern of the people of this area that we should not be subjected to any more health hazards than we have at the present time. It is submitted that there has been insufficient research and testing as to the effect on the lives of the people who are required to live in the close proximity to high voltage lines. We do not believe that the fears in this area are any different than those of persons living in other parts of the country. The CBS program "60 Minutes" which ran a Documentary on the great deal of controversy that has risen in the State of Minnesota where a high voltage line is being proposed is an example. That program greatly dramatized the feeling of everyone who is subjected to this type of treatment. There is a genuine fear not only of the damage to the property that will result from the construction of these high voltage transmission lines but from the danger of personal injury and death that may result from having them placed in our environment. Two of the very significant points that were made on the "60 Minutes" program which was shown on CBS on the 9th of October, 1977, were the statements made by one person to the effect that there is substantial evidence that these high voltage lines do in fact have a serious effect upon animal life and since the members of our non-profit corporation are primarily livestock farmers it is submitted that having these transmission lines over their property into the indefinite future will have a serious impact on their operations. Also it was important to note in the "60 Minutes" program that it was pointed out that the people of this country are being subjected to an erosion of their private rights by the actions of the big power companies in moving in and taking over and disregarding the rights of private property.

RESPONSE: See Iowa State Univerity comment 27.

See U. S. Department of Interior comment 3.

See Jean Dimmit Sedar comment 2.

COMMENT 4: It is further submitted that if it is deemed necessary to have transmission lines constructed in the three counties above referred to that there are alternative routes available which could run along railroad rights of way, along public roads and through non-productive agricultural land which could be used for the transmission line construction and if these alternative routes were selected, it would reduce the serious impact on prime agricultural land. The members of this corporation do not understand why these transmission lines could not be erected along the right of way of interstate highways where there is a very wide area from the shoulder of the road over to the abutting property.

RESPONSE: See Iowa State University comment 28.

See Charles M. Kiple comment 2.

COMMENT 5: With regard to the devaluation of farm land by the existence of the transmission lines across prime agricultural land, I would like to pass on to you the opinion of one client who is involved in a transmission line for which Iowa Southern has already obtained franchises. This person owns a 260-acre farm and with the way the power line would be placed across his land he has reached the conclusion that it would devalue his land by at least $200 per acre. On a 260-acre farm this would be a devaluation of in the sum of $52,000. With the dramatic increase in the value of farm land in the State of Iowa in the last seven years, this type of devaluation will become more dramatic in the future if the inflation in agricultural real estate continues. This devaluation is caused by many factors. In modern agriculture with larger units big equipment is necessary to farm efficiently. It is extremely difficult to farm around a transmission line tower using the large equipment. It is also submitted that where these power lines exist, it is extremely dangerous and probably impossible to spray agricultural crops in the vicinity of the towers. Also these towers would greatly hinder irrigation projects which are starting to become more popular and more necessary in light of the drought conditions which we have experienced in the State of Iowa, and what is most important to realize in connection with the erection of these transmission lines is that they are permanent fixtures which will be a problem for the farmer for many, many generations to come, and if you accumulate these damages that are sustained on an annual basis a person would have a very substantial amount of damage over his lifetime as the result of having to farm around the transmission towers.

RESPONSE: See Jean Dimmit Sedar comment 4.

See Iowa State University comment 29.

Where transmission towers are located in the center of a field, away from fences, center pivot irrigation is hindered. Line routing criteria minimizes the number of fields that would have the transmission line away from fence lines.

COMMENT 6: It has been mentioned by some of the members of our organization that consideration should be given to requiring power companies to bury this type of construction in the ground so that it will not have the adverse effect on the environment that it now has. Also a number of members of our organization feel that the whole condemnation procedure of awarding damages on a one-shot basis is unfair.

RESPONSE: See Iowa State University comment 30.

COMMENT 7: It is submitted that the Des Moines River in the summer of 1977 had very low flow and would not have been capable of even furnishing a portion of the water required by these demands.

RESPONSE: See response to Iowa State University comment 4.

COMMENT 8: At the hearing in Ottumwa it was pointed out that 17 cubic feet of water per second would be withdrawn from the Des Moines River and only 1.4 cubic feet per second would be returned to the river. It is our understanding that the water would be turned into stream and the farmers in this area are very much concerned about the atmospheric conditions which will result from this type of activity. It is further submitted that the quality of the water that is being returned to the river after having gone through the generating facility will have a very detrimental effect on the fish in the river as well as the quality of the water below the generating facility. We do not think that the State of Iowa needs to have its environment further spoiled by this type of generating facility.

RESPONSE: See response to Iowa State University comment numbers 6, 30.

COMMENT 9: One of the great concerns that the people of our ogranization as well as all of the other citizens of this country had is the great concentration of power that is being exercised by the big utility companies in this country. We have in this situation a good example of an arrogant display of power on the part of Iowa Southern Utilities Company. It is undisputed that they have spent millions of dollars without securing the required permits from the Federal Government and they also expended millions of dollars before they secured the requirement for an air quality permit from the State of Iowa. We do not believe this should be permitted because the expenditure of such substantial sums of money is bound to influence and prejudice the decision of independent agencies of the government should be able to make on an objective basis. If millions of dollars of consumers money has been spent it is likely to influence the decision of an administrative agency to go ahead and allow the permits to be issued, because there is a natural tendency on the part of administrative agencies not to want to see consumers money squandered by waste. We think that this type of activity should be halted, and an example should be made of Iowa Southern Utilities Company in this instance. These expenditures should not influence the decision of the Environmental Protection Agency in determining whether these permits should be issued. In conclusion we would like to reiterate the comments that we made at the public meeting in Ottumwa on the 28th of September, 1977. As we there stated, the people of this country are greatly frustrated by the feeling that we as individuals are being overpowered by the big utility companies and special interest groups in this country. It is because of this trend that agencies like the Environmental Protection Agency have been created by Congress to protect the people of this country from such encroachments. We hope that in the instant case that you will carefully consider all of the arguments that we have made as well as the other technical data and in the end come down with a decision that will be in the interests of all of the people of the State of Iowa.

RESPONSE: This EIS was prepared jointly by two federal agencies, the U.S.E.P.A. and the U.S. Army Engineers, since ISU applied for permits from both agencies. When an EIS is prepared by two or more agencies, one agency must accept responsibility of lead agency, which coordinates the preparation of the EIS. It was decided, with concurrence by the Corps, that EPA would be lead agency, although at this point Iowa Southern Utilities (ISU) had commenced construction and activities at the site were well under way. Since neither the NPDES permit nor the Section's 10 and 404 permits are required before a company can commence construction, ISU was able to continue construction with the full knowlege that the permits could be denied.

RESPONSES

CHARLES M. KIPLE

COMMENT 1: It is my understanding that the Environmental Impact Study states that "where possible, the right of way will be confined to areas devoted to timber and pasture land use. Intensely cultivated land will be avoided. Wherever possible structures will be located in fences or in wasteland." The line as proposed, and as shown on the attached map, would cross some of the best and most intensely cultivated land in Wapello County, Iowa. I sincerely do not believe that Iowa Southern Utilities Co. has taken an objective look at using timber, pasture, or wasteland for location of this transmission line, since I am certain that the planning of this line has been in process for some time, and it was only after I met with their officials on November 19, 1976 did they ever give any consideration to using any other route.

RESPONSE: See response to Iowa State University Comment 28.

COMMENT 2: I proposed to them at that time that they use the Rock Island Railroad right of way or the Burlington Northern Railroad right of way, lying respectively north and south of the Des Moines River through areas of wasteland, timber, and open pasture as a possible alternate route for location of the transmission lines. Instead, they have chosen to follow the path of open country, and using highly cultivated valuable farm land for location of their transmission line, and therefore affect the environment when there are other alternates available which are far less objectional. In addition, this area is now bulding up into prime rural residential in certain areas in and near the city limits of Ottumwa, particularly between the Ottumwa Municipal Airport and the northern city limits of Ottumwa and their transmission line will be in and near homes in the $100,000 plus category. All of this seems totally and absolutely unnecessary, when there is river bottom wasteland available for location of the transmission line.

RESPONSE: See response to Iowa State University Comment 28.

Paragraph 478.18, Code of Iowa, 1977, states:

> Supervision of construction-location. The state commerce commission shall have power of supervision over the construction of said transmission line and over its future operation and maintenance. Said transmission line shall be constructed near and parallel to the right of way of the railways of the state or along the division lines of the lands, according to the government survey thereof, wherever the same is practicable and reasonable, and so as not to interfere with the use by the public of the highways or streams of the state, nor unnecessarily interfere with the use of any lands by the occupant thereof.

When a transmission route is to be selected, routes parallel to railroads as well as routes along division lines of the land are considered as routes to be evaluated unless there are no railroads in the general area between the required transmission line termini.

This is evidenced by the prepared testimony presented by Iowa Southern at franchise hearings before the Iowa State Commerce Commission. In 1976 and 1977, Iowa Southern was involved in hearings for three of 161 kV transmission lines. These were:

Transmission Line	Docket Number	Hearing Date
A. Poweshiek-Beacon (Oskaloosa) 161 kV Line	E-18214 & E-18215	10/12/76
B. OGS-Wapello County (Ottumwa) #1 161 kV Line	E-18396	3/1/77
C. Reasnor-Newton 8th Street 161 kV Line	E-18531	6/7/77 & 11/22/77 Continuation

In each of these cases, a railroad route was evaluated and presented as an alternate. In cases A and B, it was found that the railroad route or routes did not offer significant savings in prime agricultural land use. In case C, the route which permitted the most extensive use of railroad-parallel construction was chosen.

As a specific example, in case B above, six alternate routes were fully evaluated for the OGS-Wapello #1 route. These alternates consisted of four railroad alternates and two "division line of the land" alternates. One of the "division line of the land" alternates was determined to be the best route by Iowa Southern and a franchise was requested on it. This routed required 0.204 acres of "Intensive Crop Land" and "Rotation Crop Land" which could be considered "prime agricultural land." Two of the railroad routes required 0.25 acres of prime agricultural land which is more than the petitioned for route. The other two railroad routes required 0.09 acres of prime agricultural land. But the extra cost for special structures and to eliminate inductive interference with existing railroad signal and communication circuits which also paralleled the railroad was from $996,000 to $1,564,000. This extrapolates to a cost of at least $8,700,000 per acre of prime agricultural land saved. After hearing testimony by the applicant (Iowa Southern), by two intervenor witnesses, by an Iowa Commerce Commission Staff witness and by six objectors, the Iowa Commerce Commission granted a franchise for the petitioned for "division line of the land" route.

Two of the four railroad routes evaluated were those suggested by Charles M. Kiple as referred to in Comment 2 by Charles M. Kiple. Mr. Kiple also represented the objectors at the franchise hearing. The other two railroad routes were selected by Iowa Southern as possible alternates.

As a second specific example in case A above, fourteen alternates were fully evaluated with testimony presented at the franchise hearing. Eight of these alternates were along a railroad and six were along division lines of the land. The petitioned for route was a "division line of the land" route and required 0.66 acres of "Intensive Crop Land" and "Rotation Crop Land" which falls in the category of "prime agricultural land." Four of the railroad routes required more prime agricultural land than did the petitioned for route. Of the other four railroad routes which required less prime agricultral land than the petitioned for route, the one with the least land usage required 0.33 acres less prime agricultural land than the petitioned for route.

The additional cost of this railroad route was $1,366,578 which extrapolates to over $4,000,000 per acre of prime agricultural land saved. The Iowa Commerce Commission granted a franchise for the "division line of the land" route after hearing testimony by the applicant (Iowa Southern), the Principal Electrical Engineer for the Iowa Commerce Commission Staff, and seven objectors.

These examples indicate that railroad routes have been evaluated in the past. Railroad route alternatives will be considered for the remaining OGS area line routes through Wapello, Mahaska, Poweshiek and any other counties as requested in James P. Rielly's Comment 5.

Since the line requirements in Wapello, Mahaska, and Poweshiek Counties are north-south lines and since the only interstate highway in any of these counties is east-west Highway 80 which lies far enough north in Poweshiek County that it will not even be crossed by any of the yet proposed lines, the right of way of interstate highways is not a viable alternative in these counties as suggested in James P. Rielly's Comment 5.

COMMENT 3: Finally, Iowa Southern Utilities Co. has stated that the line as proposed and shown on the attached map, is not pertinent to the construction of the Ottumwa Generating Station. I doubt very seriously the truthfulness of that statement for the reason that first, by the testimony of ISU officials before the Iowa Commerce Commission, they stated that the line as proposed was an outlet for the Ottumwa Generating Station, and secondly, for the reason that even assuming that the line is necessary, they can continue to use the Rock Island Railroad right of way which they use north of the Ottumwa Generating Station for a course south of the Ottumwa Generating Station down to the Wapello County Substation and they've been using that course for several decades for transmission lines. That course follows wasteland, pasture land, and timber and would have the least effect upon the environment, avoid cultivated land, and in general affect the least number of people.

RESPONSE: Starting in August 1975, the Ottumwa Generating Station (OGS) owners began studying the transmission system which would be required to transmit OGS generation to the load. This study dealt primarily with system operation, economic, and reliability aspects.

The OGS area transmission system recommended from this planning consists of 345 kV and 161 kV connections to the existing Iowa bulk power transmission system and to lines previously identified as being required to maintain Iowa bulk power transmission system reliability but not yet built. This transmission system which is required to be constructed by the commercial operation date of the OGS unit is shown in revised Figure 6-5 in the final EIS and is described below.

OGS-Oskaloosa-Poweshiek 161 kV line. This line will connect the OGS Plant to an existing 161 kV line between Des Moines and Iowa City. The Oskaloosa-Poweshiek 161 kV portion of this line will be built in 1977 and 1978 to provide transmission support to the Oskaloosa area.

OGS-Chariton 161 kV line. The OGS-Chariton 161 kV line will be built in 1980 to provide transmission support to the Chariton area.

OGS-Ottumwa (Wapello County Substation) 161 kV line around the north side of Ottumwa to complete the 161 kV tie between the Ottumwa area 161 kV and the Des Moines-Iowa City 161 kV line mentioned above. The complete tie is important for improved reliability of the area load and for general improvement of the 161 kV grid in southeast Iowa.

OGS-Ottumwa (Wapello County Substation) 161 kV line around the south side of Ottumwa. Two 161 kV lines from OGS to Ottumwa are required because of heavy power flows in this segment and to provide unit stability.

OGS-Montezuma 345 kV line. This 345 kV line will transmit power from the unit to the existing Iowa 345 kV system and help provide system stability.

As described above, some of the 161 kV lines in the OGS area are required to provide system reliability to loads and had been planned as system additions prior to the planning and final location of the Ottumwa Generating Station. These lines which are required, whether OGS exists or not, are the Poweshiek-Oskaloosa 161 kV line, a 161 kV line to Chariton (OGS-Chariton) and a complete circuit from Oskaloosa to Ottumwa (Oskaloosa-OGS-Wapello County 161 kV line). When the final planning and location of OGS was established, these circuits were adequately sized and routed through the OGS site to help export OGS power as well as provide for the previously identified system needs. If this combination of service had not been selected for these lines, lines in addition to those presently planned for the OGS area would be required.

The 345 kV line from OGS to Montezuma and the second circuit from OGS to Wapello County are specifically required for OGS to provide adequate outlet transmission and to provide unit stability.

The OGS transmission system chosen will provide the most reliability to the area loads as well as for the OGS unit for the least circuit miles of line. It also fits well with the long-range transmission requirements for the State of Iowa.

COMMENT 4: The Iowa Southern Utilities Co. objects to using railroad right of way for transmission lines for the reason that they claim the railroads will object because of inductive interference from their lines into the signaling and communications lines along the railroads. First, the Rock Island Railroad on the north side of the Des Moines River does not have any signaling or communications lines which will be affected. Second, if the Burlington Northern Railroad line on the south side of the Des Moines River were used, I feel that the railroad, who is going to haul the coal into their generating station and sell it to them indirectly, ought to be willing to bear part of the burden of the cost of protecting their lines against inductive interference, and in any case, the Iowa Southern Utilities Co. is going to have to provide protection for inductive interference near their Ottumwa Generating Station whichever course is used.

RESPONSE: See response to Iowa State University Comment 27.

RESPONSES

J. TERRENCE DENEFE

COMMENT 1: It is also my understanding that the Environmental Impact Study states that "where possible, the right of way will be confined to areas devoted to timber and pasture land use. Intensely cultivated land will be avoided. Wherever possible structures will be located in fences or in wasteland." However, the proposed "South route" does not consist of mainly timber and pasture land. The proposed "South route" crosses through intensely cultivated agricultural land, highly populated rural areas, and some rural areas which are highly commercial or industrial in nature. On behalf of my clinets I submit that there are other alternative routes available to the Iowa Southern Utilities Co. which would be more suitable when the impact on the environmental quality of the affected area is considered. My clients contend that the Iowa Southern Utilities Co. should run the proposed "South route" along either the Rock Island Railroad right of way or the Burlington Northern Railroad right of way. I am confident that Mr. Kiple's letter of October 7, 1977 adequately sets forth reasons why this should be done in lieu of the proposed "South route."

RESPONSE: See Iowa State University Comment 28.

RESPONSES

U.S. DEPARTMENT OF INTERIOR

COMMENT 1: We are unable to ascertain what the effects of the station will be on terrestrial wildlife populations. The project boundary will include 795 acres. The 1975 land use was identified as being 301 acres of corn, 147 acres of soybeans, 88 acres of hay, and 259 acres of pasture woodlands. Page IV-1 states that there will be a loss of about 3 acres of forest and 2 acres of grassland. Page IV-48 states that 77 acres of corn and 45 acres of soybeans will remain during the operating life of the Ottumwa Generating Station. Page IV-26 states that "after station operation begins, most of the site will be covered by native grasses, shrubs, and trees." However, we were unable to ascertain the acreage which will be used in the operation of the station for coal storage, ash ponds, parking, generating station, etc. The acreage utilized for physical features of the station should be identified. The final statement should state the expected acreage to be covered by native grasses, shrubs, and trees and if it will be subjected to grazing or if it could be managed to mitigate unavoidable wildlife impacts.

RESPONSE: The site will consist of approximately the following acreages.

Coal Storage	33
Ash Ponds	76
Coal Pile Runoff Pond	3
Substation	15
Generating Station	204
Grassland	86
Woodland	256
Corn	77
Soybeans	45
	795

COMMENT 2: Page IV-36 states that the intake structure is designed for an intake screen velocity of 1.0 fps at a low elevation of 639 feet MSL and approximately 0.8 fps at a normal elevation of 648 feet MSL. The Fish and Wildlife Service currently recommends that intake screen velocity be in the range of 0.30 to 0.50 fps to minimize the loss of small fishes. The final statement should indicate at what distance from the screens the approach velocities were measured.

RESPONSE: The intake structure was designed based on Standards of the Hydraulic Institute, The Hydraulic Institute, 1975. Approach velocity was determined immediately upstream of the screen face. The intake structure will be designed with a fish return chute that will return most fish that may be impinged on the traveling screens. A discussion of impingement is given in paragraph 4.0243 on page IV-32, and the intake structure is described beginning with paragraph 4.02431 on page IV-36.

COMMENT 3: The discussion of transmission lines on page VI-19 does not indicate whether the transmission lines and towers are designed to prevent raptor electrocution. This should be further addressed in the final statement since proper design can eliminate this problem.

RESPONSE: The basic electrical design for both 345 kV and 161 kV lines will comply with all requirements of the Iowa Electric Safety Code and the National Electric Safety Code. Phase-to-ground spacing as well as phase-to-phase spacing on 345 kV and 161 kV lines is greater than that on lower voltage lines. This greater spacing inherently provides less danger to birds and climbing animals than is present on lower voltage lines.

COMMENT 4: Water Bodies on the Plant Site. The draft statement on page II-81, should include a history of flooding on Avery Creek. This information is especially needed since it is pointed out on page II-82 that the creek contains several log jams and brush piles at its confluence with the river.

RESPONSE: Information does not exist concerning the flooding of Avery Creek.

COMMENT 5: Water Quality. It is noted on page IV-28, that discharge to the Des Moines River from the ash pond will be minimal except during periods of high precipitation. Monitoring should be considered on the river upstream from Avery Creek to evaluate any adverse effects on the water-quality of the river that may result from ash-pond discharge, particularly during periods of high precipitation. This monitoring program should be correlated with the current water quality studies discussed on page II-70.

RESPONSE: Please refer to the response to Iowa State University Comment 30.

Monitoring of discharges to the Des Moines River will be in accordance to EPA requirements.

COMMENT 6: Ground Water. On page II-26 of the draft statement, reference is made to Table 2-2 as listing chemical characteristics of ground water; however, the table appears to deal only with surface water. Data on the quality of ground water should be included in the final statement. The impacts of seepage to ground water from the ash ponds, although delayed, should be more adequately discussed in the statement, as many of the constituents do not decrease in toxicity with age and because they differ in sorptive effects, which may be reversible. Furthermore, field conditions and lack of absolute homogeneity in clayey material may result in differences in pollutant travel. We suggest that at least minimal downgradient monitoring of the most mobile pollutants should be considered as mitigation. It is stated on page IV-29, paragraph 4.02413, that few historical data are available on the presence of toxic or hazardous materials in ash transport waters. However, results of experimental work now in progress are available.

We refer specifically to the work of W. F. Holland, and others, concerning the environmental effects of trace elements in the pond disposal of ash and flue gas desulfurization sludge: Radian Corporation, Austin, Texas, 1975. Although these data point to considerable differences among trace elements in effects of sorption and to dependence upon grain size and distance traveled, the results definitely indicate the need for down-gradient monitoring.

RESPONSE: Please refer to response to Iowa State University Comment 9.

COMMENT 7: Archaeology. The letters of clearance received from the Iowa State Archaeologist and the Iowa State Historic Preservation Officer, referenced on page II-61, should be appended to the final statement.

RESPONSE: The letters will be included in the Final EIS as suggested.

COMMENT 8: It is noted that specific archaeological site information is given on pages A-8, A-9, A-10, and A-37. In the preparation of the final statement, we suggest that consideration be given to the desirability of deleting these pages to minimize the possibility that the sites might be disturbed by amateur archaeologists.

RESPONSE: The information referred to has been published in a report issued by the Office of the Iowa State Archaeologist entitled "Final Report of Archaeological Investigations at the Site of the Ottumwa Generating Station, Chillicothe, Iowa." In addition, the sites have been thoroughly investigated by professional archaeologists, and the area cleared for construction activities by the Iowa State Archaeologist and the Iowa Historic Preservation Officer. Access to the plant site area also is controlled. It appears that it is unnecessary to delete the archaeological site location information.

COMMENT 9: Outdoor Recreation. Subsections 4.01202, 4.01203, and 4.01205 make references respectively to previous sections 4.01191, 4.01192, and 4.01194. We were unable to locate these sections in the documents; therefore, the discussions of direct and indirect construction effects and labor force and employment characteristics were somewhat unclear and left only a vague impression of what those effects and characteristics are. The missing sections should be included in the final statement, and the actual impacts of construction activities clarified.

RESPONSE: The number of the referenced paragraphs will be corrected.

A discussion of construction impacts was added to the EIS as follows.

"4.01211

a. Construction period impacts on public facilities and services will take the form of temporary requirements for housing, school facilities, and community services such as churches and indoor and outdoor recreational facilities. The magnitude of these impacts will be primarily determined by where the construction workers migrating to the study area will locate. The manner in which these new resident workers and their families are likely to locate, assuming they will locate within a reasonable commuting distance, can be estimated by employing a gravity model as found in both the physical and social sciences. This model expresses the relatively greater attractiveness of larger towns than small towns, and of towns closer to the site than those at greater commuting distances. It also indicates that a small town close to the site may be as attractive as a larger town more distance from the site. When this type of analysis is employed, using the peak construction year work force of 457 in 1979 (Table 4-2), it appears that the majority of the construction workers and their families will locate in Ottumwa, Chillicothe, or Oskaloosa. The percentage increase in population will be significant only in Chillicothe. As previously stated in paragraph 2.0433, Chillicothe is a "bedroom community" offering few services to its residents. As a result of this lack of public facilities and services, and allowing for the proximity of the City of Ottumwa, it seems reasonable to assume that the residents of Chillicothe have, and will continue to depend on Ottumwa for the services and facilities which their community does not provide. In light of this assumption, the expected additional residents in Chillicothe will have a negligible impact on the available facilities and services."

COMMENT 10: Recreational facilities in the 3-county study area should be more thoroughly examined. Page II-57 notes that the City of Ottumwa has ample recreational space for its population. However, construction workers and their families migrating to the area may choose to locate in surrounding smaller communities where impacts on social facilities may be greater. In clarifying construction impacts in the final statement, we feel recreation should be included and discussed from that standpoint.

RESPONSE: Construction period impacts on public facilities and services will take the form of temporary requirements for housing, school facilities, and community services such as churches and indoor and outdoor recreational facilities. The magnitude of these impacts will be primarily determined by where the construction workers migrating to the study area will locate. The manner in which these new resident workers and their families are likely to locate, assuming they will locate within a reasonable commuting distance, can be estimated by employing a gravity model as found in both the physical and social sciences. This model expressed the relatively greater attractiveness of larger towns than small towns, and of towns closer to the site than those at greater commuting distances. It also indicates that a small town close to the site may be as attractive as a larger town more distant from the site. When this type of analysis is employed, using the peak new resident work force of 457 in 1979 (Table 4-2), it appears that the majority of the construction workers and their families will locate in Ottumwa, Chillicothe, or Oskaloosa. The percentage increase in population will be significant only in Chillicothe. As previously stated in paragraph 2.0433, Chillicothe is a "bedroom community" offering few services to its residents. As result of this lack of public facilities and services, and allowing for the proximity of the City of Ottumwa, it seems reasonable to assume that the residents of Chillicothe have, and will continue to depend on Ottumwa for the services and facilities which their community does not provide. In light of this assumption, the expected additional residents in Chillicothe will have a negligible impact on the available facilities and services.

COMMENT 11: We note on page VI-19 that the final selection of transmission line routes has not been made. In doing so, the applicants should be aware of Section 6(f) of the Land and Water Conservation Fund Act of 1965 as amended. Section 6(f) states, "No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive state-wide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness land location." Should the final routes of the transmission lines cross such an area, the final statement should indicate application to the Secretary of the Interior for the required conversion.

RESPONSE: All landowners, parties who hold interest in affected land and jurisdictional agencies are notified of the informational meetings and franchise hearings as discussed in "Iowa State Comment 15." This requirement will be met if appropriate.

RESPONSES

U.S. DEPARTMENT OF TRANSPORTATION

COMMENT 1: Section 1.046. Approximately 60 permanent employees will be required to operate the station. This Draft EIS makes no mention of the effect this daily traffic increase will have on the local road system. Some upgrading of the local system may be required.

RESPONSE: It appears that the road system to the OGS site presently is adequate to handle the traffic created by operating personnel. The people working at the facility will work three shifts per day, and traffic will be distributed over a 24-hour period. Assuming that the majority of the plant personnel will live in or near Ottumwa, they will drive approximately 20 miles round trip each day. If one third or 20 employees participate in car pools with four people in a vehicle, a total of about 45 vehicles would be used in providing transportation. This would amount to approximately 900 vehicle miles traveled per day as a result of the operation of OGS.

COMMENT 2: Section 1.0481. An additional 175 to 250 trains a year will be required to supply coal to the plant. The effect this additional train traffic will have on existing highway-railroad crossings should be addressed. Additional signs or new separations may be necessary.

RESPONSE: The Burlington-Northern Railroad will be responsible for maintaining crossings, and for determining the need for additional signs or new separations.

Approximately three to five trains per week will deliver coal to the OGS site. This additional number of trains are not expected to cause any appreciable problems at highway crossings.

COMMENT 3: Sections 6.08 to 6.0833. These sections concern the transmission lines necessary to distribute the generated power. Before the locations of the lines are determined, coordination with the Iowa Department of Transportation and the affected counties should be established so that conflicts between the transmission lines and existing or proposed highways will be minimized. Poles for the transmission lines should be located at least 30 feet from the edge of any roadway.

RESPONSE: State regulations require a minimum distance from the edge of any roadway to the transmission line. This regulation will be complied with. See response to Iowa State University Comments 15, 28, and 29.

RESPONSES

U.S. DEPARTMENT OF COMMERCE

COMMENT 1: The subject DEIS contains no assessment of the environmental impact of the plant's heat dissipation system, and the heat dissipation system is not described sufficiently to allow an estimate to be made.

RESPONSE: Please refer to response to the Iowa State University Comment 27.

COMMENT 2: The abscissa scale on Figure 2-6 needs correction. The figure cannot be read quantitatively from the two identifical scale entries now entered.

RESPONSE: The upper scale entry was corrected to read "100,000."

RESPONSES

NATIONAL WILDLIFE FEDERATION

COMMENT 1: The DEIS is silent regarding EPA's compliance with the consultation and mitigation requirements of the Fish and Wildlife Coordination Act (FWCA). Section IX of the DEIS describes the consultation procedures followed with other agencies regarding, for example, protection of historic properties, but does not reveal what steps were taken to coordinate with the U.S. Fish and Wildlife Service regarding protection of the fish and wildlife resources of the Des Moines River. Nor does the section on alternatives consider measures to mitigate damage to or loss of these resources. Such measures would include acquisition of replacement habitat for the "approximately 795 acres of agricultural land and wildlife habitat which will be converted to industrial use," selection of the least adverse cooling system, quantification of the expected entrainment/impingement losses, and consideration of artificial aquatic reproduction.

The consultation and mitigation requirements are, of course, fully applicable to the issuance of a new source NPDES permit. *cf*, 40 CFR §125.14 (f) (1973); USFWS *Navigable Waters Handbook*, §1.2, 40 FR 55811 (1975); and *Sun Enterprises Ltd., v. Train*, 532 F2nd 280, 288 (2d Cir. 1976).

The Federation recommends that mitigation features such as those referred to above be developed with the assistance of the USFWS, and discussed in the final statement. In the event of a decision to issue the NPDES permit, we recommend the incorporation of suitable mitigation features as special conditions.

RESPONSE: Any mitigation features required by the NPDES permit will be implemented.

APPENDIX I

PUBLIC HEARING PROCEEDINGS

BEFORE THE

ENVIRONMENTAL PROTECTION AGENCY

PUBLIC HEARING concerning

ENVIRONMENTAL IMPACT STATEMENT, DRAFT,
Ottumwa Generating Station
Iowa Southern Utilities Company

Building 41, Room 209,
Indian Hills Community College,
Ottumwa,
Iowa,

Wednesday, September 28, 1977.

The above-entitled hearing convened, pursuant to notice, at 7:40 p.m.

PANEL MEMBERS

DAVID TRIPP, ESQ., Hearing Officer.

MARY JEAN O'DONNELL, ESQ., Project Leader, Environmental Impact Statement on the Ottumwa Generating Station.

ALSO PARTICIPATING

ED VEST, Head, Environmental Impact Review Group, EPA, Region VII.

JIM OLANDER, Environmental Impact Review Group, EPA, Region VII.

MIKE TURBY, Permit Secion, EPA, Region VII.

BOB CHANCELLOR, Air Quality Section, EPA, Region VII.

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PROCEEDINGS

HEARING OFFICER DAVID TRIPP: The hearing will come to order and we'll commence with our proceedings.

For the record, I'll note that the hearing has commenced at approximately 7:40 p.m., on September 28, 1977.

My name is David Tripp. I am the Chief of the Legal Branch for Region VII of the United States Environmental Protection Agency in Kansas City.

I was assigned the responsibility for conducting this hearing by Dr. Kathleen Camin, Regional Administrator, EPA on August 22, 1977.

In my position as Chief of the Legal Branch, I have no direct responsibility for environmental impact statement preparation or review or for any other matters that presently involve the Ottumwa Generating Station. And I will attempt to conduct the hearing in an impartial and unbiased manner.

The purpose of this hearing, as most of you are probably aware, is to inquiry into the environmental consequences of the proposed generating station.

The plant will require a national pollutant discharge elimination system permit pursuant to the Federal Water Pollution Control Act. The National Environmental Policy Act is applicable to the project through the operation of law and requires compliance with the Executive Order No. 11514 which implements the National Environmental Policy Act. And it is also subject to the Counsel and Environmental Quality Regulations which were published on August 1, 1973.

Those regulations and those laws require on major federal activities which significantly affect the quality of human environment that the Agency inquire into the environmental effects of the project, the alternatives which should be considered, any unavoidable consequences and methods for restoring the enviornment, protecting the environment, as well as other considerations.

So the basic purpose of this hearing is to gather public testimony as required by those laws and regulations concerning the environmental consequences as a project.

And the hearing has been convened because the regulations require that when there is significant public interest such a hearing be held.

I'll just say a word or two about the conduct of the hearing. This is basically a public hearing. It is not a judiciary type hearing with presentation of witnesses or cross-examination. So we will be more or less informal and relaxed as we proceed.

I have asked that everyone who intends to speak fill out one of these cards which were available at the door and this is primarily for the use of our court reporter so that she may identify everybody in the record and make sure we have proper identification.

If you have not filled out one of these cards and wish to speak, I would appreciate it if you would for her benefit.

This will not be construed as a limitation on your speaking. We would ask that you come to the microphone and speak up here if you can because the hearing will be recorded for her benefit. So please come to the front.If you feel like you would not necessarily like to, if you would stand and speak in a clear voice and the court reporter can hear you, you may speak from where you sit. in the audience.

The only reservation that I'll make on the hearing is that I will try to limit any testimony that may be unduly repetitious or irrelevant.

When the presentations have finished and we do have some cards from some people who would like to make presentations in addition to the EPA staff, we will allow questions from the floor of the EPA people or any representatives of Iowa Southern or their representatives who might be here.

Before we proceed with the presentations, I would like to introduce the EPA staff. On my right is Mary Jean O'Donnell who is the principal EIS reviewer. I believe in the back of the room is Ed Vest--would you stand please--who is the head of the Environmental Impact Review Group in Region VII. Mr. Jim Olander is there who works in that office. In the front is Mike Turby who works with the Permit Section of EPA and Bob Chancellor who works with the Air Quality Section.

I understand we also have present in the audience Mr. George Savage who is with the Consulting Engineer, Black and Veatch, on this project and Mr. Don McCloud who is a Vice-President of Iowa Southern. And if we have any particular questions which might be more appropriately answered by those people, we will direct them to them.

Mary Jean, if you would like to proceed?

MS. O'DONNELL: Thank you, Dave.

As Dave mentioned, my name is Mary Jean O'Donnell. I am with the U.S. Environmental Protection Agency's Kansas City Office.

By the way, can you hear me in the back? It is O.K.?

SPEAKER: Yes.

MS. O'DONNELL: I am Project Leader for the Environmental Impact Statement on the Ottumwa Generating Station.

First and foremost, before going into details about the EIS and the power plant, I would like to welcome all of you to this meeting and to tell you that the primary purpose of this hearing is to receive comments and questions, any questions that you may have upon our draft EIS.

I especially encourage your participation in the development of this document. We at EPA need and welcome any comments or questions you may have regarding EPA's enviornmental analysis of this project. And even if after this meeting you may have comments or questions, please don't hestitate to write or contact us at EPA. Your ideas will be taken into account in the finalization of the EIS.

Before describing the legal basis for this EIS and EPA's role in its development, I would like to briefly describe the subject of this whole study, namely the Ottumwa Generating Station. As many of you know, Iowa Southern Utilities has proposed to establish a fossil-fueled, steam-electric generating station.

Its location is eight miles northwest of Ottumwa, Iowa adjacent to the Des Moines River and also to the town of Chillicothe, Iowa.

The estimated cost of this power plant is $300 million. As designed, the plant will generate 727 megawatts of electricity and will burn low-sulfur Wyoming coal at a rate of approximately two million tons per year.

The principal constituents of the stack emissions from this plant are various trace elements, which are inherent in low-sulfur coal, also particulate matter and oxides of sulfur and nitrogen.

Now briefly, in terms of water usage, the Ottumwa Power Plant, which by the way will utilize closed-cycle cooling to cut down on water usage, will draw water from the Des Moines River at a rate of approximately 17 cubic feet per second. The plant will discharge water to the Des Moines River at a rate of approximately 1.4 cubic feet per second.

Now because of this need to draw from and discharge water to the Des Moines River, Iowa Southern Utilities is required to seek federal permits under the Federal Water Pollution Control Act Amendments of 1972.

Under Section No. 402 of this Act, a permit is required for any discharge of pollutants into the navigable waters of the United States. This permit program, which is sometimes called the National Pollutant Discharge Elimination System, is administered by the U.S. Environmental Protection Agency.

There is another section of this Act which applies to power plants. Under Section No. 404 of this Act, a permit is also required for the discharge of dredged or sill material into the navigable waters of the U.S. This program is carried out by the U.S. Army Engineers.

Also, I might add at this point, a permit is also required under Section No. 10 of the River and Harbors Act of 1899. This Act regulates, among other things, placement of structures in navigable waters of the U.S. This applies to the power plant in regard to the intake structure that will be built in the river.

This program, this Section No. 10 Permit Program, is administered by the U.S. Army Engineers also.

In brief, these are the laws which generated the need for the permits for this particular plant. The permits which relate in any case to EIS work. The law which generated the EIS is the National Environmental Policy Act of 1969.

Under this Act, any federal agency is required to prepare an EIS on any of their proposed actions that they determine will have a significant impact upon the quality of the human environment. Such a NEPA determination, as it is sometimes called, was made by the Army Engineers early in '74 and the EIS, in conjunction with the environmental assessment, was started at that time.

In 1975, when it was determined that an EPA discharge permit would be required for this plant, EPA assumed lead agency responsibility for preparing the EIS. Army Engineers participation in the EIS continued and the result is that this draft EIS is a multi-agency document. It satisfies both the Army Engineers and EPA's requirements for preparing an EIS on their respective proposed permit actions.

In addition to the Army Engineers and EPA, other organizations are participating in EIS preparation. These are Iowa Southern Utilities--they are the principal owners and operators of the Ottumwa Power Plant. Additional companies share ownership. These are Iowa Public Service Company, the Iowa-Illinois Gas and Electric Company and Iowa Power and Light Company.

Black and Veatch Consulting Engineers are preparers of the engineering facilities plant and the EIS.

In regard to content of the EIS, the major topic studies as they are listed in the document are: air quality impacts, water quality impacts, to look at it a different way, impacts from construction activities, impacts of operation, primary impacts occur, they cite very specific secondardy impacts which are--you might say in other words impacts that might result from impacts, effects of effects.

We also take into consideration alternatives to the proposed project in terms of alternative methods of energy generation, alternative particulate removal methods, site selection. We take into consideration relationship between short term uses of man's environment and maintenance and enhancement of long term productivity and irreversible or irretrievable commitment of resources and the like.

A public information meeting was held June 23, 1976 here at the Indian Hills Community College. It was sponsored by EPA. Its purpose was to explain EPA's newly established roles in the Ottumwa Generating Station Project.

The draft EIS was mailed out from our office for review on August 10, 1977. Notice of its availability was published by the President's Council on Environmental Quality in the Federal Register. And that date was August 29, 1977.

Now this last date is significant because the official 45-day review period begins the day this notice is published in the Federal Register.

By the way, a 15-day extension to this 45-day review period has recently been granted for anyone who is reviewing this document.

The notice of the public hearing on the draft EIS was published in the Ottumwa Courier on September 3, 4 and 5 and in the Des Moines Register on September 3, 5 and 6.

And the notice reads as follows: "Notice is hereby given that on September 28, 1977 at 7:30 p.m. the U.S. Environmental Protection Agency, EPA, Region VII, will hold a public hearing at the Indian Hills Community College, Building No. 41, Room No. 209 at the Ottumwa Industrial Airport, Ottumwa, Iowa.

"The purpose of the hearing is to allow all interested parties an opportunity to express their views and to provide information regarding the draft environmental impact statement for the Ottumwa Generating Station.

"Copies of the draft EIS are available at

EPA, Region VII. They are also available for public review at public libraries in Ottumwa and Des Moines, Iowa."

The draft EIS lists the federal, state and local agencies, private organizations, interested individuals, anyone who has requested a copy of the draft EIS, anyone who has received a draft EIS for review, for an opportunity for review.

To date, EPA has received replies from the Housing and Urban Development Administration, the Iowa A-95 Clearing House and the Federal Aviation Administration. And no comments, positive or negative, were made by these Agencies.

So, in conclusion, I again encourage you to review and comment on this document, if you will. We seek your participation. And I think you for your attention.

HEARING OFFICER TRIPP: Thank you, Mary Jean.

I have a number of cards from the public. Before we proceed, are there any federal, state or local legislative representatives present who would like to make any comment or presentation? Or any federal, state or local governmental agencies?

(No response.)

HEARING OFFICER TRIPP: Hearing none, we will proceed to members of the public.

The first card I have is from Mrs. J. E. McDermott, representing McDermott Farms.

Mrs. McDermott, would you like to come to the microphone?

MRS. MC DERMOTT: I think possibly what I have to say might be better taken up later after some of the comments about the plant itself and the environment are made.

HEARING OFFICER TRIPP: Yes, you will have an opportunity for questions later.

MRS. MC DERMOTT: Thank you.

HEARING OFFICER TRIPP: I have a card from Mr. Ron Van Veldhuizen, representing Tri-County Property Rights Association, Incorporated.

MR. VAN VELDHUIZEN: Yes, the question I have is why the discrepancy--now this concerns transmission routes--why the discrepancy between the draft EIS and the proposed routes that Iowa Southern has proposed to take?

MS. O'DONNELL: The discrepancy is because of the process that Iowa Southern Utilities has to go through to establish acceptable routes by the Iowa Commerce Commission and by--then finally one approved, I would like to direct that question in particular to, let's see, Mr. McCloud. I think that Iowa Southern can probably explain that process better as to why the discrepancy.

HEARING OFFICER TRIPP: If I could make a suggestion, excuse me.

If anybody has any presentation they would like to make, let's proceed with that first and then we will get into questions and answers. I think it will probably multiply when we start having questions.

Do either Mr. Plate or Mr. Rielly, do you have a presentation to make?

MR. RIELLY: Yes.

HEARING OFFICER TRIPP: All right, let's proceed with that first and then we will get to the questions.

The name is Mr. Ernest Plate representing Tri-County Agricultural Property Rights--I'm sorry, it is Mr. Rielly.

MR. RIELLY: I am Jim Rielly. I am a lawyer from Oskaloosa. I am with the Spade and Rielly Law Office.

I have been retained by a nonprofit organization which is known as the Tri-County Agricultural Property Rights Association which is persons who are directly affected by the construction of this plant and primarily by the construction of transmission lines, the electric transmission lines which are going to serve this plant.

I can say that I represent in excess of 300 persons who belong to our organization. And they are very much concerned about the impact that this proposed project and primarily the transmission lines which will be a part of this project will have on their life and on the environment in which they live.

First of all, we would like to suggest that because of the fact that Congress has not yet completed work on the National Energy Act and has not established an energy policy for country, we think it is premature to be allowing the construction of a major--of major plants of this nature. It is hoped by many of us that we will see some real conservation implemented through the National Energy Policy that is adopted by the Congress and by the administration.

And we question whether there is going to be a need for the further construction of this type of a facility which is going to have such a severe impact not only on the lives of the people that live around the plant, but on the--but in the path of all of these huge transmission lines which are going to be carrying this energy throughout the country.

In our county alone and Mahaska County north of us, this project alone is spawning two major lines. As Ron Van Veldhuizen has suggested, in your environmental impact statement, you have not even alluded to one of these lines. I assume that you are aware of the situation because you have acknowledged the fact that the statement does not cover the line which would run to the east of the one that is shown in the book.

Now in your environmental impact statement, Page VI-20, there is a section which is 6.08218. It is a statement in which you say, "Where possible, the right-of-way will be confined to areas devoted to timber and pasture land use. Intensively cultivated areas will be avoided."

Now that is just a plain false statement if we are to look at what has actually been done in two of these--in the transmission lines which--for which franchises have been granted by the Iowa Commerce Commission for the transmission line that runs through the western part of Mahaska County. The condemnation juries have awarded to set the amount of damages--and these are extremely high. All these have been appealed to District Court, at least the ones I am aware of. in Mahaska County.

I was shocked by the amount of money that the profession jury has awarded. This would indicate that they are taking very high level, prime agricultural land in the path of this power line. The impact is very dramatic.

These lines are dangerous. You can't spray. This big agricultural equipment that you have got, it is very difficult to cultivate around these big lines. They are dangerous if you have anything, any grain-handling facilities in the area. And it is submitted that that is just not a true statement in this impact statement because they are taking excellent, some of the best, prime farmland in this country is being subjected to these major lines. And we think this should be re-examined.

Also, we would like to know when the question and answer period comes whether Iowa Southern Utilities is acquirity substantial coal lease rights and mineral rights in this area. If so, we think this is going to have a major impact because we all know what strip mining does to the enviornment. And we hope that our part of the state is not going to be ravaged any further than what it has in the past several years.

We think also that if you going to allow this sort of activity, it should be confined to those areas that are not going to affect people's lives as severely as what has been proposed in the one line for which they already have the franchises and the other line which is being proposed.

And incidentally, this one that you do not mention in your book would have a severe impact on prime, agricultural land. If you travel through the south of Mahaska County, this--well, in fact, the whole distance of this in our County would go through some of the best agricultural land in the Midwest or in the county for that matter.

We think this would have a very severe impact and shouldn't be permitted.

Now one of the things that has really bothered my clients and myself is the fact that Iowa Southern Utilities Company has been allowed to proceed with such substantial expenditures of money before they obtain these permits.

I assume that they do not have these permits to which you alluded, that this is the purpose--one of the purposes of this hearing.

We all know that they have spent very substantial amounts of money so far. And I hope that this will not cause any Agency, this Agency or any other, to be influenced by the fact that they have made usbstantial economic investments. We think that this is a very arrogant display of economic power and we don't think this is right. I don't think the common people of this country should be subjected to this sort of activity.

There is great frustration, as you all know, in this country about the great economic power of the big oil companies and the big utility companies. And we have to look at an Agency such as yours to protect our rights. Because we don't have the economic power. We don't have the money, the expertise, the engineers, the people like this to go to bat.

So we are hoping that you will take a second look at this situation before you complete your studies and take all of these problems into consideration.

Thank you.

HEARING OFFICER TRIPP: Thank you, Mr. Rielly.

Mr. Plate, did you wish to make a presentation?

MR. PLATE: If it would be possible, I would like to reserve a little time for later during the questioning.

HEARING OFFICER TRIPP: All right.

Those are all the cards that I have of anyone requesting to make a presentation.

Is there anybody else in the audience who would like to make a presentation?

(No response.)

HEARING OFFICER TRIPP: Mr. Van Veldhuizen, we can return to your question now if you would like to proceed with it.

MR. VAN VELDHUIZEN: Yes.

Would you like me to restate the question?

HEARING OFFICER TRIPP: If you would, please.

MR. VAN VELDHUIZEN: Why the discrepancy bewteen the EIS and the proposed transmission route the power company has proposed to take? I might say routes.

MS. O'DONNELL: I would like to refer that question to Mr. Phil Brunk. of ISU.

MR. BRUNK: Thank you, Mary. I am Phil Brunk, Director of Environmental Affairs.

HEARING OFFICER TRIPP: Excuse me, Mr. Brunk.

Would you please come up so the Court Reporter can be sure to get you on the tape?

MR. BRUNK: I am the Director of Environmental Affairs for Iowa Southern.

I understand the question has to do with the difference in the transmission systems shown in the draft EIS and the--and a corridor or a transmission line proposal that was made by the Company in February of this year.

And the answer to that is as an EIS is put together, formulated, during the very early stages of planning for a power station, there are many things in the EIS that are not set in concrete, so to speak.

In direct answer to the question, the present proposed route is the one that was proposed in the February informational meeting. The routes--and you will notice there are a couple of alternatives in the EIS--the proposed 345 Route pretty much replaces both of the alternatives and is the current proposal.

It is only a proposal. We don't know where that transmission system will go. We have not received, we have not even applied to the Iowa Commerce Commission who has the final word in this area.

When we do finally get an indication of where this system will go when we have some more direction in this matter and the Iowa Commerce Commission makes their decision, then we will know where they will go.

But presently, we do not. I couldn't stand here and tell you exactly what that transmission system will be.

MRS. MC DERMOTT: Still, we got a notice that it would be, that it was definite.

MR. BRUNK: No, it's not. It is a proposal. If you notice--the notice is a proposal.

MRS. MC DERMOTT: The notice was kind of recent.

MR. BRUNK: The system you are talking about has nothing to do with the Ottumwa Generating Station.

The Ottumwa Generating Station is the 345 Route that was proposed in the February meeting that comes from the OGS Station straight north.

The other systems that are being built are part of the Ottumwa--or the Iowa Southern Transmission System, but have nothing to do with the Ottumwa Generating Station. It would be there anyway, no matter.

We have not received any franchises from the Iowa Commerce Commission concerning the route proposals for the Ottumwa Generating Station.

MRS. MC MERMOTT: That is not for this station?

MR. BRUNK: No.

The 345 that runs from the Ottumwa Generating Station straight north to in Poweshiek County is a proposed system.

We think our engineering shows this to be an efficient route and we are trying to get that franchise by the Commission, but we have not done so as yet.

And that is the only line that is really totally dependent that the Ottumwa Generating Station has made necessary. The other lines would be there anyway.

HEARING OFFICER TRIPP: Mr. Van Veldhuizen, do you with to follow up on your question or does that answer your question?

MR. VAN VELDHUIZEN: Yes, I would like to know how this gentleman believes this to be a most efficient route when it goes right up through the most prime productive lands in the Midwest?

MR. BRUNK: I am not an expert. I don't intend to get into a argument concerning one route or another. I don't know anything about that.

Electrically and financially, it is the most effective route that we have been able to find.

HEARING OFFICER TRIPP: Thank you, Mr. Brunk.

While he is standing there, if anybody has any question they would particularly like to direct to Mr. Brunk, this would be an appropriate time for it.

Would you identify yourself, please?

MR. GODDARD: My name is Ron Goddard. I am a Biologist.

I am concerned, as are enviornmental--as the Director of Environmental Affairs at the Utility that you have no expertise in helping plan where that route ought to be, ought to go?

MR. BRUNK: No. I say I am not an electrical engineer. It is the electrical engineers that plan those routes.

MR. GOODARD: In conjunction with environmental concerns?

MR. BRUNK: Oh, certainly.

MR. GODDARD: Or economic concerns?

MR. BRUNK: Mostly economic concerns; elextrical concerns are of great importance. Environmental are also there. But the electricians and the economists plan the lines. The environmentals veto or don't.

MR. GODDARD: What I am asking is are you planning short-term or long-term environmentally?

MR. BRUNK: Long-term.

HEARING OFFICER TRIPP: Is there a question on this side of the room? Yes, sir?

Would you identify yourself?

MR. WRIGHT: I am Rex Wright. I am a Mahaska County farmer.

This proposed line would run through, on the proposed route, approximately a mile of farmland. On alternative routes, it would be about a mile and a half.

I saw a piece in the Des Moines Paper that the City of Cedar Rapids cannot wait until this plant is completed and in generation so they can have electricity.

And it looks to me like for everybody concerned--there would be no high lines or nothing--the plant could be built at Cedar Rapids to furnish that electricity. They surely have the railroads to bring the coal in there. And there would be no need for this transmission line altogether.

Now this is my opinion.

MR. BRUNK: That might solve Cedar Rapids problem, but what would it do for Iowa Southern's territory?

MR. WRIGHT: Well, according to the paper, this is where the most electricity that is being built to sell to, Cedar Rapids.

MR. BRUNK: That is not true.

MR. WRIGHT: This was in the financial column in the Des Moines Register.

MR. BRUNK: I have no responsibility for the Des Moines Register or the Des Moines Tribune.

The plant--and Mary explained the ownership of the plant--Iowa Southern owns 48 percent of the plant. Iowa Illinois Gas and Electric, Iowa Power and Light and Iowa

Public Service also own portions of the plant. Iowa Electric Light and Power of Cedar Rapids has purchased part of our 48 percent for a short period of time.

MR. WRIGHT: I've been told this high line in the western part of the County has already been developed or is already being developed, that as soon as this is all completed--it belongs to Iowa Southern now--it will be sold and turned over to Iowa Power and Light because they couldn't get the line through.

MR. BRUNK: Well, that is erroneous information.

HEARING OFFICER TRIPP: Was there another question, Mr. Rielly?

MR. RIELLY: Well, I'd like to know if it is not true that you actually are going through intensively cultivated areas with these high lines? Do you concede that that is a true statement?

MR. BRUNK: I have not been over the route. But I would guess that would be--

MR. RIELLY: Is there anybody here from the Company that does know that we can get a concession of? Because this statement in this impact statement is not true. You are going through intensively cultivated land.

MR. BRUNK: What does the statement say?

MR. RIELLY: It says "Intensively cultivated areas will be avoided."

MR. BRUNK: Where possible.

MR. RIELLY: No, it doesn't say where possible.

It says, "Wherever possible, structures will be located in fences or in wasteland."

There is a period after the word avoided.

Now that's just not a true statement and do you agree with me it is not true?

MR. BRUNK: I am not--I would have to look at my--

MR. RIELLY: Well, is there anybody here from your Company that is conversant with this?

MR. BRUNK: I don't think so. We don't have any right-of-way people here today.

MR. RIELLY: Why not?

MR. BRUNK: Because this is a public hearing. It is not a question and answer session and not a debate.

MR. RIELLY: Well--

MR. BRUNK: We are not prepared--

MR. RIELLY: The very substantial awards were just made by a comdemnation jury when they asked the County for prime farmland. that have all been appealed by your Company.

MR. BRUNK: Yes, sir.

MR. RIELLY: You want this, but you don't want to pay for it.

You don't want to pay the farmer, but you can spend $300 million dollars to build a plant, but you don't want to pay the farmer for his land.

MR. BRUNK: That is beside the point. Those awards and that line have nothing to do with the plant.

MR. RIELLY: Well, I bet you that those lines will carry generating electricity from this plant, will they not?

MR. BRUNK: I will guess they will.

MR. RIELLY: Then I think they are part of the plant.

It wouldn't be economically feasible to build those lines if you weren't going to--

MR. BRUNK: Those lines were planned long before this plant was even in the planning stages. And those lines will be there anyway. A line in that area will have to be there.

I guess you guys understand that if we didn't build this plant it would take more transmission lines than it does if we do build the plant because we would have to be bringing the power in.

MR. RIELLY: Well, I don't think you were at the hearing before the Commerce Commission where I was there.

And this plant was alluded to and that transmission line was--the franchises were sought for that line and they did allude to the need for this line because of this new generating plant.

And you had lawyers and you had engineers who laid the rail testifying to that effect. It is just the opposite from what you are trying to make us believe here this evening.

MR. BRUNK: Well, I am just saying this evening that we have not received any franchises.

MR. RIELLY: The other question I have is are you buying--are you acquiring coal leases and mineral rights in the several counties in this area, your Company?

MR. BRUNK: No.

Do you want a longer answer than that?

MR. RIELLY: No. Is that the true answer, that is what I am getting at?

Is that the truth?

MR. BRUNK: Are you questioning my veracity?

MR. RIELLY: Well, I just said you alluded--do you want a longer answer. I just wondered if you wanted to explain it.

MR. BRUNK: I could talk for quite awhile about why we are not and all those kinds of things.

We are not buying any Iowa coal for anything other than the Bridgeport Generating Station.

MR. RIELLY: You are not acquiring any mineral rights?

MR. BRUNK: No.

MR. RIELLY: O.K.

HEARING OFFICER TRIPP: Thank you, Mr. Brunk.

Mrs. McDermott, we skipped over you. I am sorry. Do you have any further questions?

MRS. MC DERMOTT: No. Since they are not talking about the line that is going through my land brought in from the east, the alternative route, the two alternative routes, they are going through our prime farmland. Mr. Brunk said this was from a plant north.

They had planned to go through our farmland, our prime land, bringing it in from the east and there were the two alternative routes they had. If it is not a pertinent question, then there will be no discussion.

But I should think that the power will be coming from the new plant.

HEARING OFFICER TRIPP: That is a question?

MRS. MC DERMOTT: Yes.

HEARING OFFICER TRIPP: O.K.

Mr. Brunk, could you hear that?

MR. BRUNK: No.

HEARING OFFICER TRIPP: I'm sorry.

MRS. MC DERMOTT: I was asking about the power line that is proposed to go through our land. And I gathered from your answer that this was not in consideration in the hearing tonight?

MR. BRUNK: No, it's really not because it is not a part of the Ottumwa Generating Station. And it is a line that we hope to put in service before the Ottumwa Generating Station is in operation.

We need it whether we have the Ottumwa Generating Station or not.

MRS. MC DERMOTT: I was worrying about the alternative routes. We have some of our best productive land around there.

Is there any hope for it not being there?

MR. BRUNK: Do you think that the existence of the line would affect your property, will affect production of it?

MRS. MC DERMOTT: Very much, yes.

MR. BRUNK: How?

MRS. MC DERMOTT: I figured it out mathematically. For the easement, the last meeting that we came to we were told it would be 100 foot. I figured up the loss of land that this would hold, the air that they would take and the loss of production. It would be $20,000.00 or $30,000.00.

MR. BRUNK: You mean the 100 foot strip?

MRS. MC DERMOTT: Yes.

MR. BRUNK: You still use the 100 foot strip?

MRS. MC DERMOTT: Not with the posts up. It is impossible to get the equipment near them or under the lines.

We are being paid for just the easement.

MR. BRUNK: That doesn't approximate the value of the land?

MRS. MC DERMOTT: No.

MR. BRUNK: Well, at any rate, it is not a part of the Ottumwa Generating Plant System. It is not for this hearing.

I am not a right-of-way person. I am an environmental person, the Environmental Director. There are all kinds of arguments.

HEARING OFFICER TRIPP: Mrs. McDermott, I am sorry, but the reporter is having a hard time hearing you with your back to her like that.

MRS. MC DERMOTT: I am sorry.

HEARING OFFICER TRIPP: Could I suggest--Mr. Brunk is telling you that he doesn't think this is a part of the hearing.

MRS. MC DERMOTT: Right.

HEARING OFFICER TRIPP: And I am not--what I would suggest to you is this. If you feel that what is happening to your property is the result, either directly or indirectly, of the construction of the Ottumwa Plant, that you make written comments to that effect and provide them to EPA.

MRS. MC DERMOTT: Those are my comments.

HEARING OFFICER TRIPP: All right.

Thank you, Mr. Brunk.

Mr. Plate, did we get to your question?

MR. PLATE: I would like to dwell on a couple of things.

On Roman Numeral VI-19, down at the bottom, "Crops and pasture land use under transmission lines can be carried on with no disturbance."

Of this, I can make just one comment and I am a farmer and I say hogwash.

This isn't realistic. You don't put a six row planter or an eight row hoe down through a power line that's got eight frames on that. You just don't do that.

You farm around it and raise weeds. Or you can spray the area to death with chemical. But don't tell me that there will be no disturbance. It isn't that way.

And also, there's nothing in the book about ozone or anything of that nature. I have seven children and I will be directly affected by this line. The route is a mile up to close to two miles, depending on which way they feel that they desire to go.

Which brings me to my next question on this proposed route. We had an informational meeting about it on the 31st of March and the Right-of-Way Supervisor, Mr. Kelley for ISU stood up and told us--we didn't take it to understand it was a proposed route, we take it that the line is coming through this corridor. We were lead to believe that.

And along now in July, they have done an altogether different map here. There is nothing--this is nothing to like what we were told. And there has been surveys and a lot of expense. We just want to know why.

That is all I have to say.

MS. O'DONNELL: We would hope to address the question of ozone and the updated transmission lines in the final EIS.

We will reconsider that section.

MR. RIELLY: I would like to make one point in rebuttal to what Brunk has said. He said that this line which I was talking about where they had actually got the franchises and for which they made their condemnation is not affected. But this transmission you've shown is on VI-21 in your impact statement. So it is definitely a part of this project or you wouldn't have it in the impact statement.

I think what he is saying is not true at all.

HEARING OFFICER TRIPP: Are there any other questions from the audience concerning the issues that have been discussed or any other of the environmental consequences of the construction of the plant?

Yes, in the back, would you identify yourself, please?

MR. STEWART: I am John Stewart.

I have three questions. One thing, Mr. Brunk said long-term, that we were looking at the long-term aspects of this . What is long-term?

Do you mean EPA, Iowa Southern--how do they look at long-term? Is it 30 years? Life of the generating plant that you look at? Is that what you mean by long-term? We are looking down the road. Is this long-term long past the time I will be in the ground?

MR. BRUNK: The long term effects are addressed in the irretrievable effects of the plant, the resources that are committed basically forever. That is addressed in the environmental impact statement.

MR. STEWART: I did get to look at the statement. I spent some time with it.

Even though the--we have food and discharge into the Des Moines River. As I understand it, that discharge is within acceptable levels, is that correct?

Is that acceptable levels from the standpoint of that water coming out of the discharge unit itself, not on its own merit? Or is that acceptable, an acceptable level within the entire frame of the Des Moines River?

Below the Ottumwa Power Generating Plant, as I understand, water isn't even considered safe for contact sports like swimming, boating, that kind of thing.

It is above the river, but then it is all contiguous, one goes together. Are you not then dumping more into the river?

If the pollutant is already there in the river and we don't already have a good situation as it is, if you dump more in, you surely can't be helping it,whether that individual or that separate water coming in may meet standards, because it contributes to a greater pollution, isn't that pollution in itself then?

MS. O'DONNELL: Yes. We have to direct-- we have to address the cumulative impact of a discharge into a river, not simply to consider the discharge itself, but consider all the discharges and the water quality and integrity of the river.

But I would like to direct the specifics of that question to our permanent man, Mike Turvey. I think he can give you more detailed information.

MR. TURVEY: I am Mike Turvey, EPA, Kansas City.

The question about the discharges from the proposed plant, the information we have in the permit application would indicate the plant is being designed to meet our regulations.

Perhaps that is an adequate answer.

MR. STEWART: Well, I guess what I am asking, I know you say it is not going to pollut any more, but it is not going to pollut any less either, is it? Isn't that correct?

MR. TURVEY: Well, that is correct, yes.

Really, the Water Quality Act should really be more adquately answered by a member of the Iowa Department of Environmental Quality. And I don't know if they have a representative here tonight or not.

MR. STEWART: You have answered my question about it and I appreciate it.

My last question and then I will sit down for the time being is I understand that Iowa Southern is going to use nothing but low-sulfur western or Wyoming coal.

I can read that and believe it. And I don't want to call Iowa Southern a liar. I am not saying that at all. I am just saying I am looking at it as a skeptical person. See, we have a lot of coal in Iowa. As time progresses, I wouldn't want--and being aware that there is a coal-washing plant being considered for this area, this vicinity. The trick is to wash Iowa coal.

Are we going to be looking at a sometime when we are going to be burning Iowa coal in that plant? I guess that is what I am asking. Or is it for sure not going to burn Iowa coal.

I guess I would direct that to Iowa Southern.

MR. MC CLOUD: I am Don Mc Cloud, Iowa Southern. I expect you can all hear me.

We would like nothing better than to burn Iowa coal. It is more economical that the other sort of coal.

However, the environmental requirement for emissions in the plant, together with the economics of cleaning the combustion products from the Iowa coal dictate that we not burn Iowa coal.

Yet, in all fairness, we have no intention of burning Iowa coal in the forseeable future at all barring changes in the environmental laws or changes in the economic laws or something like that. We do not anticipate it. We have a long-term contract for Wyoming coal and that is what we expect to burn forever.

MR. STEWART: Thank you.

HEARING OFFICER TRIPP: Thank you, Mr. Stewart.

Are there any further questions about any aspects of the environmental impact of the plant?

(No response.)

HEARING OFFICER TRIPP: Are there any further comments from any representatives of the Utility or their consultant concerning any of the matters raised tonight?

(No response.)

HEARING OFFICER TRIPP: If there are none, then that will conclude the public comment at this hearing.

I will remind you that the record will be kept open for that 45-day period which I believe runs from August 29, 1977 with the 15-day extension. So you can calculate that. And if you have any written comments, direct them to Mary Jean O'Donnell at United States Environmental Protection Agency, 1735 Baltimore, Kansas City, Missouri. They will be considered in the final publication.

If there are no further comments or questions, I thank you for your participation and questions.

(Whereupon, at 8:40 o'clock p.m., September 28, 1977, the hearing in the above-entitled matter was closed.)

CERTIFICATE

I, KAY L. ARGIE, do hereby certify that I appeared at the time and place first hereinbefore set forth; that I took down in Stenomask the entire proceedings had at said time and place; that the foregoing thirty-eight (38) pages constitute a true, correct and complete transcript of my said Stenomask notes.

Kay L. Argie

Reporter.